An Investigation Into The Accessibility Of Massive Open Online Courses (MOOCs)

Thesis

An Investigation into the accessibility of Massive Open Online Courses (MOOCs)

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Acknowledgements

After becoming a Computer Scientist in Madrid and having lived in Brussels, Amsterdam and Finland, who would guess that I would end up at thirty-something doing a PhD in Milton Keynes? It is not an easy question, but like everything it has an explanation. Madrid is a city that offers you a rich cultural life, entertainment and, in my case, a childhood. Yet, whilst Madrid offered all these things, friends and family, I could not find a job that I liked. During those seven years dedicated to consultancy; dealing with customers in suits and ties, overworking (that last bit has not changed) and feeling completely unrealised, I decided to do an MSc in Educational Technology while working. For that, the best place was UNED and that was the beginning of the end.

Over time I decided that I would start a part-time PhD. Following this the next step was to quit my job and dedicate myself full-time to the doctorate. The jump to the Open University was a logical but not obvious one. My previous supervisors were part of the reason why I took this leap, and they were who supported me during the transition. The Global OER Graduate Network (GO-GN) also influenced my choice of university. I attended several of their seminars and lived through its transition from the Open University of The Netherlands to the Institute of Educational Technology.

I would like to take this opportunity to thank those who have been key in getting me to this point in my life. First, I would like to thank my supervisors Patrick McAndrew, Shailey Minocha and Tim Coughlan for their unconditional support. Without the backing of Covadonga Rodrigo, this journey would not have been successful. Besides my supervision team, special thanks go to Rebecca Ferguson, Timothy Read, Bart Rienties and Eileen Scanlon. To Fred Mulder for inspiring my interest in Open Education and its importance in doctoral research and to Martin Weller for tweeting the PhD scholarship I would finally apply for. I appreciate the effort of my examiners Jane Seale and Russell Beale.

The PhD is a long journey and it is important to have people around who can distract you from your thoughts. Thanks to my IET friends, those within the OU and Milton Keynes and in my hometown Madrid. You know who you are. The most special thanks go to my parents, Paco and Carmen.

The accessibility audit was possible with the expertise of Chetz Colwell, Nick Freear, Graham Healing, Garron Hillaire, Darko Jansen, Kate Lister and Alejandro Rodríguez-Ascaso. I appreciate the support given by OpenTEL, this doctoral research has been funded and is part of the Open World Learning programme supported by The Leverhulme Trust.

Abstract

Massive Open Online Courses (MOOCs) are an evolution of open online learning that enables people to study online and for little or no cost. MOOCs can provide learners with the flexibility to learn, opportunities for social learning, and the chance to gain new skills and knowledge. While MOOCs have the potential to also bring these benefits to disabled learners, there is little understanding of how accessibility is embedded in the creation of MOOCs. The goal of this research has been to understand the accessibility barriers in MOOCs and to develop processes to identify and address those barriers.

In the extant literature, the expectations of disabled learners when they take up MOOCs are not discussed and studies on MOOCs that report demographic data of learners do not consider disabled learners. However, disabled learners can face difficulties in accessing MOOCs, and certain learning designs of MOOCs may affect their engagement, causing them to miss out on opportunities offered by MOOCs. Technologies and the learning design approaches for MOOCs need to be as accessible as possible, so that learners can use MOOCs in a range of contexts, including via assistive technologies.

This research has investigated the current state of accessibility in MOOCs. It has involved the following:

- Interviews with 26 MOOC providers; including software developers, accessibility managers, inclusion designers, instructional designers, course editors and learning media developers;
- Comparative quantitative survey data involving disabled and non-disabled learners participating in 14 MOOCs;
- Interviews with 15 disabled learners which have captured their experiences; and
- An accessibility audit was devised and then used to evaluate MOOCs from 4 major platforms: FutureLearn, edX, Coursera and Canvas. This audit comprises 4 components: technical accessibility, user experience (UX), quality and learning design; 10 experts were involved in its design and validation.

This research programme has yielded an understanding of how MOOC providers cater for disabled learners, the motivations of disabled learners when taking part in MOOCs, and how MOOCs should be designed to be accessible for disabled learners. A range of barriers to accessibility in MOOCs have been identified, and an accessibility audit for MOOCs has been proposed.

An open online learning environment should take into account learners' abilities, learning goals, where learning takes place, and the different devices learners use. The research outcomes will be beneficial to MOOC providers to support the accessible design of MOOCs, including the educational resources and the platforms where the MOOCs are hosted. The ultimate beneficiaries of this research project are MOOC learners because accessible MOOCs will help support their lifelong learning and provide re-skilling opportunities.

Declaration of Authorship

Parts of the research in this thesis have been published. Some of those publications outlined below are based on this research while others are of my previous and related work. Portions of the publications are adapted and included in the narrative. My PhD supervisors and fellow researchers are credited co-authorship due to their input into my research conceptualisation and design. Although co-authors provided comments on full drafts, the research, the analysis, and majority of the writing are my own.

References to Relevant Work and chapters	**Chapters**	**PhD Research**
Iniesto, F., Rodrigo, C., & Moreira Teixeira, A. (2014). Accessibility analysis in MOOC platforms. A case study: UNED COMA and UAbiMOOC. *In V Congreso Internacional sobre Calidad y Accesibilidad de la Formación Virtual (CAFVIR 2014)* 545–550. http://oro.open.ac.uk/45192/	3 & 7	No
Iniesto, F., & Rodrigo, C. (2014). Accessibility assessment of MOOC platforms in Spanish: UNED COMA, COLMENIA and MiríadaX. *In 2014 International Symposium on Computers in Education (SIIE)* 169-172. IEEE http://oro.open.ac.uk/45193/	3 & 7	No
Iniesto, F., McAndrew, P., Minocha, S., & Coughlan, T. (2016). The current state of accessibility of MOOCs: What are the next steps? *In Open Education Global Conference 2016, 12-14 Apr 2016, Krakow, Poland.* http://oro.open.ac.uk/46070/	2, 3 & 7	Yes
Iniesto, F., & Rodrigo, C. (2016). Strategies for improving the level of accessibility in the design of MOOC-based learning services. *In International Symposium on Computers in Education (SIIE), 14-16 Sep 2016, Salamanca, Spain.* IEEE. http://oro.open.ac.uk/47501/	2, 3 & 7	No
Iniesto, F., McAndrew, P., Minocha, S., & Coughlan, T. (2016). Accessibility of MOOCs: Understanding the Provider Perspective. *Journal of Interactive Media in Education, 2016(1)*, article no. 20. http://oro.open.ac.uk/48073/	2, 3, 4 & 9	Yes
Iniesto, F., & Rodrigo, C. (2016). A preliminary study for developing accessible MOOC Services. *Journal of Accessibility and Design for All*, 6(2) 126–150. http://oro.open.ac.uk/47947/	3	No
Iniesto, F., McAndrew, P., Minocha, S., & Coughlan, T. (2017). What are the expectations of disabled learners when participating in a MOOC? *In L@S 2017: Fourth (2017) ACM Conference on Learning @ Scale Proceedings, 20-21 Apr 2017, Cambridge, MA, USA*. http://oro.open.ac.uk/48666/	2, 3 & 5	Yes
Iniesto, F., McAndrew, P., Minocha, S., & Coughlan, T. (2017). Auditing the accessibility of Massive Open Online Courses (MOOCs). *In 14th AAATE Congress 2017, 13-14 Sep 2017, Sheffield*. http://oro.open.ac.uk/50394/	2, 3 & 7	Yes
Iniesto, F., McAndrew, P., Minocha, S., & Coughlan, T. (2017). An investigation into the perspectives of providers and learners on MOOC accessibility. *In TEEM'17: international conference technological ecosystems for enhancing multiculturalism, 18-20 Oct 2017, Cadiz, Spain* http://oro.open.ac.uk/50955/	2 - 7	Yes

List of Abbreviations

- AD - Accessible Design
- AEM - accessibility evaluation method
- ARIA - Accessible Rich Internet Applications
- AT - Assistive technology
- ATAG - Authoring Tool Accessibility Guidelines
- BERA - British Educational Research Association
- CAST - Center for Applied Special Technology
- CC- creative commons
- CPD - Continuing Professional Development
- CUD - Center for Universal Design
- D4A - Design for All
- DI - Differentiated instruction
- EADTU - European Association of Distance Teaching Universities
- ECO - E-learning, Communication and Open-data
- ESL- English as a Second Language
- EU4ALL - European Unified Framework for Accessible Lifelong Learning
- FL - FutureLearn
- FLAN - FutureLearn Academic Network
- FPL- Fully Participating Learners
- FUN - France université numérique
- GDPR - General Data Protection Regulation
- GLC - Global Learning Consortium
- GO-GN - Global OER graduate network
- HCI - Human Computer Interaction
- HE - Higher Education
- HESA - Higher Education Statistics Agency
- HREC - Human Research Ethics Committee
- ICT - Information and Communication Technology
- ID - Inclusive Design
- IDRC OCAD University – Inclusive Design Research Centre, Ontario College of Art and Design University
- IET - Institute of Educational Technology
- LMS - Learning Management System
- MOOC – Massive Open Online Course
- MOOCAP - MOOCs for Accessibility Partnership
- OA - Open access
- OER - Open Educational Resources
- OLA - Open Learning and Accessibility
- OSS - Open Source Software
- OS - Online Surveys
- OS - Operative System
- OU - Open University
- OWL - Open World Learning
- P2P - Peer to Peer
- PCP - Person-Centred Planning
- PD - Participatory Design
- QAA - Quality Assurance Agency for Higher Education at the UK
- ROER4D - The Research on OERs for Development project
- UCD - User Centred Design
- UD - Universal Design
- UDforI - Universal Design for Instruction
- UDI - Universal Design for Instruction
- UDL - Universal Design for Learning
- UDT - Universally designed teaching
- UID - Universal Instructional Design
- UNED - National Distance Education University
- UWEM - Unified Web Evaluation Methodology
- UX - user experience
- VLE - Virtual Learning Environment
- WAI - Web Accessibility Initiative
- WBG - World Bank Group
- WCAG - Web Content Accessibility Guidelines

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1. Introduction

Massive Open Online Courses (MOOCs) have changed online learning by offering millions of learners the possibility of accessing online courses at a low cost (Mulder, 2015)[1]. MOOCs developed from a base in the pedagogical theory of connectivism with active learners who contribute to building knowledge collaboratively (Downes, 2012; Siemens, 2012). The current pedagogical model for MOOCs tends to adapt already existing university courses and offer an extended online version (Anders, 2015).

Although the disruptive force claimed by MOOCs in online learning (Conole, 2013) has been criticised (Littlejohn & Hood, 2017), from the point of view of learner as customer MOOCs are products that have the potential to be used to rethink online learning. Achieving social inclusion via online learning by embedding inclusive strategies, and the importance of targeting vulnerable groups is emphasised in the literature (Barrera et al., 2017; de Waard et al., 2014). Even though most learners who sign up for MOOCs may not complete them (Watted & Barak, 2018), research shows that there are benefits for those who participate in them. For instance, vulnerable groups are more likely to report benefits of MOOCs training, such as for continuing professional development (CPD) (Zhenghao et al., 2015) supporting some of the early hopes that MOOCs can provide a lifelong learning opportunity.

There is little reported work on how accessibility is embedded in design of MOOCs. At the same time, the need to incorporate greater access has been highlighted; two significant events have contributed to the call for attention to the accessibility of online learning. The first was in 2015 when MOOC provider edX had to reach an agreement to include accessible content on its platform. edX decided to change its policies and include accessibility in its software development cycle. This settlement includes arguments that continue to be important (US Department of Justice, 2015):

> *MOOCs have the potential to increase access to high-quality education for people facing income, distance, and other barriers, but only if they are truly open to everyone. This landmark agreement is far-reaching in ensuring that individuals with disabilities will have an equal opportunity to independently and conveniently access quality higher education online.*

The second event in 2016 led to a different approach taken by Berkeley University when facing a similar situation (Jaschik, 2016). Berkeley decided to remove more than 20,000 audio and video files from its online open-access platforms; requiring learners sign in with University of California credentials to view or listen to them instead of investing in making the content accessible. Legislation is shown here as a driver of accessibility. In Europe, FutureLearn (FL) has made up-front decisions about accessibility and was

1 American Phycological Association (APA) style citation is used in this thesis. The use of et al. is determined by the number of authors and whether it is the first time a reference has been cited in the paper. Articles with one or two authors include all names in every in-text citation; articles with three, four, or five authors include all names in the first in-text citation but are abbreviated to the first author name plus et al. upon subsequent citations; and articles with six or more authors are abbreviated to the first author name plus et al. for all in-text citations.

encouraged to do this by its parent university, UK's Open University (OU), based on their experience in this area and their commitment to openness[2].

Being aware of the risks of technological determinism (Knox, 2016), technologies have the potential to offer opportunities to disabled learners to improve their wellbeing through socialisation, lifelong learning, and for re-skilling and employability (Dillahunt et al., 2016). Any online learning environment, including MOOCs, should take into account learners' abilities, learning goals, where learning takes place, and which devices learners use (Hood et al., 2015). Technologies used in MOOC platforms are not necessarily accessible which may then block access to learning to a significant number of learners. Further, the use within MOOCs of videos, peer to peer assignments (P2P) which involve learners evaluating each other, quizzes and tests, or, in general, activities that increase the need for collaboration in online learning all can create additional challenges for accessibility (Rodrigo et al., 2016).

MOOCs can be beneficial when compared to other online learning opportunities because of their characteristics of openness within a structured learning framework and low cost of learning (Barrera et al., 2017). The scope of individual planning regarding learners' self-organisation of time, the use of their preferred devices, opportunities for social learning, and the chance to gain new knowledge are some additional advantages (Scanlon et al., 2015). The importance of accessibility to online educational resources is widely acknowledged (Acosta & Luján-Mora, 2016) but there is limited discussion about the accessible design of online learning courses including MOOCs. Providing accessible MOOCs could offer the flexibility of learning and benefits to all learners. Indeed, the Porto Declaration on MOOCs (EADTU, 2014, p. 2) highlights the aspect of providing opportunities to all:

> *MOOCs must not be seen as the outcome or exemplar of online education. Rather they need to be understood in a wider context as there is a long history of research on open and online education and a variety of approaches and tools to provide quality learning opportunities to all.*

A published report on inclusive teaching and learning in higher education (HE) (Department of Education, 2017) encourages HE providers to care and offer support and develop an optimal environment for disabled learners. The lifelong learning paradigm integrates education, work and personal life in a continuous process and allows learners to be able to access the knowledge and develop it both personally and through work (Butcher & Rose-Adams, 2015). In this respect, if accessible, MOOCs have the characteristics to provide an appropriate mode of study for disabled learners. However, there is a lack of research about the number of disabled learners and their interest in MOOCs, the efforts that MOOC providers are taking towards MOOCs accessibility and the current state of MOOC accessibility (Sanchez-Gordon & Luján-Mora, 2017).

[2] FutureLearn accessibility and inclusion policy, https://about.futurelearn.com/terms/accessibility-policy

1.1 Synopsis of this research

This research has aimed to better understand the accessibility barriers in MOOCs and to develop processes to identify and address these barriers. In order to do so the MOOC providers' viewpoints on accessibility and disabled learners' motivations have been explored. The research questions addressed are:

- **RQ1**. How do MOOC providers cater for disabled learners?
- **RQ2**. What are the motivations of disabled learners when taking part in MOOCs?
- **RQ3**. How can MOOCs be made accessible for disabled learners?
    - **RQ3a**. What is the current state of accessibility of MOOCs?
    - **RQ3b**. How can accessibility barriers in MOOCs be identified and addressed?

As Twining, Heller, Nussbaum, & Tsai (2017) indicate, and considering the underlying epistemology, this research was framed in a pragmatic approach. For this research, a mixed methods-research programme has been designed to understand the complexity of the issues related to accessibility and MOOCs.

In qualitative studies involving interviews, the MOOC providers' viewpoints on accessibility and disabled learners' motivations have been explored in this research project. The quantitative analysis of survey data has provided an understanding of the demographics and experience of disabled learners who take up MOOCs compared to non-disabled[3]. To assess the current state of MOOC accessibility, identify and address accessibility barriers, a MOOC accessibility audit was designed to evaluate MOOCs; this audit comprises four components: accessibility, user experience (UX), quality and learning design. Several accessibility experts participated in the design and validation of the MOOC accessibility audit.

To address the research questions three studies have been carried out:

- **Study A** that includes a set of interviews with those that provide MOOCs (**RQ1** and **RQ3**).
- **Study B** that employs data from surveys collected in FL and interviews with disabled learners (**RQ2** and **RQ3**).
- **Study C** that contains the MOOC accessibility audit (**RQ3**).

1.2 The context of this research

This doctoral research has been funded and is part of the Open World Learning (OWL) programme at The OU supported by The Leverhulme Trust[4]. I have a Bachelor degree (Hons) in Computer Science from the Autonomous University of Madrid (UAM) and a MSc in Educational Technology from National Distance

[3] When referring to non-disabled learners, it implies that these are learners who have not declared a disability
[4] OWL, https://iet.open.ac.uk/projects/owl

Education University (UNED). The Master's degree thesis was titled: *"Accessibility and standardisation in the cycle of creation of educational resources".* Before joining the OU as a full-time PhD research student, I was a part-time PhD student at UNED, in the Department of languages and computer systems. During that time, I joined the Global Open Educational Resource (OER) network (GO-GN)[5], which fostered my interest in Open Education. During that time the focus of the research was on MOOCs accessibility, taking a computer science approach and centred on the personalisation of online learning. The research was titled *"Accessibility in eLearning platforms: a case study in MOOCs"*. This preliminary research has formed the basis of the MOOC accessibility audit presented in this thesis. The title of the proposal submitted to join the OU was "*Accessibility and MOOCs: an adaptive model for developing services for disabled learners"*.

During this Doctorate, I have kept in contact and collaborated with several researchers at UNED, supervising two students (one undergraduate and one master) in their research on accessibility in MOOCs. I have collaborated in several research projects related to the scope of this research such as those developed by UNED-Vodafone Foundation Chair and Open Learning and Accessibility (OLA!), a project between the Institute of Educational Technology (IET) and the Department of Artificial Intelligence at UNED. Internally in the OU, I have participated in the project *"Optimising devices for disabled students for on-screen study"* and in the international project *"Accessible Resources for Cultural Heritage EcoSystems (ARCHES)"*[6] as a library supporter. I have joined the FutureLearn Academic Network (FLAN)[7] and the Accessible Online Learning Community Group from W3C[8].

During this doctorate, three research visits have influenced the research methodology and enriched my experience:

- First, in November 2016, there was a visit to the inclusive design research centre (IDRC)[9] at OCAD University: *"the IDRC is a research and development centre to ensure that emerging information technology and practices are designed inclusively".*

- The second visit was in April 2017 to the Centre for Applied Special Technology (CAST)[10]: "*CAST is a non-profit education research and development organisation that works to expand learning opportunities for all individuals through Universal Design for Learning (UDL)."* This visit included meetings with researchers on accessibility at edX, MIT Office of Digital Learning and HarvardX.

- The third visit was to the Centre for Research Ceibal Foundation[11] in June 2018; where their main initiative, among many others, is the joint fund *"Digital Inclusion: Education with New*

[5] GO-GN, https://go-gn.net/
[6] ARCHES, https://www.arches-project.eu/
[7] FLAN, https://partners.futurelearn.com/
[8] AccessLearn, https://www.w3.org/community/accesslearn/
[9] IDRC, https://idrc.ocadu.ca/
[10] CAST, http://www.cast.org/
[11] Ceibal Foundation, https://fundacionceibal.edu.uy/en/

Horizons" promoting the use of educational technology in Uruguay and Latin America for social inclusion.

1.3 Contributions of the thesis

The combination of qualitative studies through interviews with MOOC providers and learners and the quantitative information provided by the MOOC survey data has provided an in-depth and multi-faceted insight into accessibility needs MOOC learners. The MOOC accessibility audit has helped to identify accessibility barriers and the audit provides a tool that can be further developed and used to support the design and evaluation of MOOCs for accessibility.

This research has recognised the value of considering both provider and learner opinions. While the development of accessible educational resources requires clear accessibility policies in organisations, it is also essential to have a focus on learners. Considering learner preferences and requirements in learning design and practices, rather than aiming to follow the minimum legal requirements. For that reason, this thesis has provided findings that should lead to more accessible MOOCs and increase awareness among the various stakeholders in need for accessibility in this educational environment.

This research will benefit the MOOC providers who will be able to use the outputs of this (the accessibility audit and empirical research) and will benefit MOOC learners participating in accessible designed MOOCs. To support dissemination, those providers interviewed in Study A will be contacted to share with them the research findings and the accessibility audit to discuss its applicability and further research to develop accessibility guidelines.

1.4 Organisation of the thesis

This thesis is organised as follows:

- **Chapter 2.** A critical review of the literature and development of the research questions.
- **Chapter 3.** The methodology is outlined, describing the epistemology, research methods, and the research design.
- **Chapter 4.** Study A: interviews with 26 MOOC providers to understand the perspectives of those involved in the production of platforms, in the educational design of courses and research in the MOOC community.
- **Chapters 5 and 6.** Study B: involving analysis of the survey data of disabled and non-disabled learners participating in 14 FL MOOCs (Chapter 5); and, interviews with 15 FL disabled learners which captured their experiences (Chapter 6).
- **Chapters 7 and 8**. Study C: the design of the accessibility audit for evaluating MOOCs (Chapter 7); and, the implementation and validation of this audit and the results of the audit (Chapter 8).

- **Chapter 9.** Final discussion reflecting on the outcomes, limitations of this research, and topics for future research.

2. Literature review

This chapter presents the literature review and develops the research questions for this research.

2.1 Introduction

This chapter first introduces concepts of disability, accessibility and inclusive design (**Section 2.2**). Then the importance of accessibility within education, and e-learning in particular is discussed (**Section 2.3**). In **Section 2.4**, I reflect on how during the course of this doctoral research, MOOCs have evolved and changed. In **Section 2.5**, a definition for MOOCs in this research is presented, setting out their structure and stakeholders. **Section 2.6** discusses the MOOC providers' perspectives while **Section 2.7** does it with the learners' perspectives leading to **RQ1** and **RQ2**, respectively. **RQ3** and its two sub-questions, which pertain to the accessibility in MOOCs, are defined in **Section 2.8**. The research questions are then brought back together in **Section 2.9** with the conclusion and summary of this chapter is presented in **Section 2.10**.

2.2 Disability, accessibility and inclusive design

This section introduces several definitions that will be used in the thesis. As Oliver (2017) claims definitions related to accessibility appear in the literature and are variable depending on the context. There are several ways of defining disability: Smart & Smart (2006) and Seale (2014) discuss some definitions based on models.

The medical model places disabled people in stigmatising categories of impairment, understood as the limitation of a person's physical, mental or sensory function on a long-term basis (Bickenbach, 1993). This model has driven, and still does, charity and administrative models, including formal definitions of disability (Seale, 2014). In HE it can be seen in the way Higher Education Statistics Agency (HESA)[12] asks universities to report and classify their students' data.

The social and environmental model considers the functions of both the individual and the individual's environment. Disability is defined around the skills, abilities, and achievements of the individual in addition to biological factors (Thomason et al., 1998). Understanding of disability under this model should take into account the social and cultural environment of the individual, such as their age or economic difficulties (Scope[13]).

The affirmation model tries to describe more of the day-to-day lives of disabled people; disability is framed in the discrimination found in the broader society and how individuals can be empowered to pursue their own goals (Hahn, 1997; Swain & French, 2000).

Mole (2013) indicates, with the passage of years, disability definitions do not cover just deficits and participation restrictions, and now include aspects of the individuals' interaction with their health and

[12] HESA, https://www.hesa.ac.uk/
[13] Scope, https://www.scope.org.uk/about-us/social-model-of-disability

contextual factors (which may be environmental or personal). As Oliver (2017) argues, the relationship between impairment and disability is influenced by the different ways to provide services that address disability. Coughlan & Lister (2018) mention the discomfort of the students in HE with the language used when discussing disability, and reflect on the view of disability offered by the models which cluster students. The views of these authors indicate there is not one correct model, and focus should be on ways in which students should feel comfortable when discussing disability.

In this research project, the medical model of defining disability will be used when referring to the data collected from HESA; this enables consistency with other research and labels used across the education sector. Overall the research design follows a social and environment model of disability, and this thesis has not been framed to map by disabilities. Each of the models of defining disability, when applied in this thesis, will be referred to at the point of use. Disability in this research project is predominantly referred to via self-identification, and the definition is consistent with the social model as used by Scope:

> *Disability is caused by the way society is organised, rather than by a person's impairment or difference (including age, cultural environment and economic difficulties). It looks at ways of removing barriers that restrict life choices for disabled people. When barriers are removed, disabled people can be independent and equal in society, with choice and control over their own lives.*

There are two further concepts to be defined: usability and accessibility, identifying the critical relationship between the two. Usability focuses on designing a product to meet users' expectations and adapting it to their needs with efficiency and ease such that it enables optimal use by the target users (Yonaitis, 2002). Accessibility and usability are related as less accessibility implies low usability; non-accessible content is not usable; however usable content may not necessarily be accessible (Petrie & Bevan, 2009). The definition of accessibility in the context of this thesis is based on and adapted from Global Learning Consortium (GLC)[14]:

> *Accessibility is the ability of the learning environment to adjust to the needs of all learners. Accessibility is determined by the flexibility of the education environment (with respect to presentation, control methods, access modality, and learner supports) and the availability of adequate alternative-but-equivalent content and activities. Accessible systems adjust the user interface of the learning environment, locate needed resources and adjust the properties of the resources to match the needs and preferences of the user.*

And Petrie, Savva, & Power (2015, p. 1) definition:

> *All people, particularly disabled and older people, can use websites in a range of contexts of use, including mainstream and assistive technologies; to achieve this, websites need to be designed and developed to support usability across these contexts.*

The adapted definition of accessibility, as applied to MOOCs and used in this thesis, is:

> *Accessibility is the ability of the* MOOC environment *to adjust to the needs of all learners and is determined by the flexibility of the platform, with respect to presentation, access modality, and learner support and the availability of adequate alternative but equivalent educational resources and assignments. All learners can use MOOCs in a range of contexts of use, including mainstream and*

[14] IMS global consortium, https://www.imsglobal.org/activity/accessibility

assistive technologies; to achieve this MOOCs need to be designed and developed, to consider technical and learning design aspects, to support usability across these contexts.

This definition of MOOC accessibility encompasses the relationship between accessibility and usability. This perspective on accessibility can be applied to a learning design context. This definition also emphasises that accessibility affects all learners (Meyer et al., 2014; Toetenel & Bryan, 2015).

There are several other related approaches to design for accessibility. The term barrier-free-design was introduced in the 1950s in the USA (Berube, 1981). New approaches have evolved such as a user-centred focus in User-Centred Design (UCD) and Accessible Design (AD), or a Universal Design (UD) perspective such as Design for All (D4A) (Kinzie et al., 2002; Persson et al., 2015).

The definition of Inclusive Design (ID), as used in this thesis, is adapted from the British Standards Institute[15] and Persson et al. (2015, p. 509):

The design of mainstream products and services that are accessible to, and usable by, as many people as reasonably possible on a global basis, in a wide variety of situations and to the greatest extent possible without the need for special adaptation or specialised design.

And the Cambridge Inclusive Toolkit[16]:

Inclusive design guides an appropriate design response to diversity in the population through: developing a family of products and derivatives to provide the best possible coverage of the population, ensuring that each individual product has clear and distinct target users and reducing the level of ability required to use each product, in order to improve the user experience for a broad range of customers, in a variety of situations.

The adapted and complemented definition of inclusive design as applied to MOOCs and as used in this thesis, is:

Inclusive design is the design of MOOC platforms and courses that are accessible to, and usable by, as many learners as reasonably possible without the need for special adaptation or specialised design. Ensuring that MOOCs have clear and distinct target learners and reducing the level of ability required to use MOOCs, to improve the user experience for a broad range of learners, in a variety of situations.

ID is suitable in a massive online environment such as MOOCs where an individualised learning experience can be achieved through the personalisation of the learning environment (Sein-Echaluce et al., 2017). Both ID and UCD approaches have been used in this research and which will be described in the methodology (**Section 3.6**).

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[15] British Standards Institute (2005) standard BS 7000-6:2005: 'Design management systems - Managing inclusive design', https://www.designcouncil.org.uk/bs-7000-62005-design-management-systems-managing-inclusive-design-guide

[16] Cambridge inclusive design toolkit, http://www.inclusivedesigntoolkit.com/whatis/whatis.html

2.3 Accessibility in Education

Disability affects 15% of the world population, approximately one billion people (WHO, 2011). The number of disabled students that use assistive technologies or require adaptations to be able to access HE resources is increasing every year (Moriña, 2017). A widening participation summary taken from UK Performance Indicators for 2018[17] shows participation of students in HE who are in receipt of disabled students' allowance is 6.6% having increased from 4.5% in 2008 and 1.5% in 2001.

Coughlan, Rodriguez-Ascaso, Iniesto, & Jelfs (2016) and Moriña (2017) show that there is an increase of disabled students in the education system, across all types of HE institutions and in particular in distance universities, which is likely to reflect the higher flexibility they offer for their students. The researcher at the beginning of the PhD contacted several distance universities to understand the numbers and proportions of disabled learners, including OU (UK), UNED, Open University of Catalonia (UOC) (Spain), OU-UAb (Portugal) and OU (The Netherlands). Responses received from UOC, OU-UAb and OU Netherlands showed that they are developing organisational accessibility policies in their institutions. The first two, the largest within the European context have extensive experience catering for disabled learners in e-learning.

The reports produced by these two institutions confirm there is a growing proportion of disabled students who choose distance education. The OU has more disabled students than any other university in the UK and Europe (The Open University, 2018a), OU's Annual Report states there are over 24,000 students with declared disabilities enrolled at the OU. The analysis shows a rise in students declaring a disability from 6.8% in 2010/11 to 18.5% in 2017/18 (The Open University, 2018b). In the case of UNED numbers have increased from 2,500 in 2003/2004 to 7,400 in 2016/17 which represents 50% of total Spanish disabled students (UNIDIS, 2017). These data are framed in the context that learners have become more aware of benefits of declaring a disability, it is easier to declare a disability than in the past, and the categories used now are broader and are more inclusive (Cooper, 2014). Disabled students face different situations when attending HE (Seale et al., 2015) and research shows there are still differences in the pass rate for disabled students (Rienties et al., 2016) and Richardson (2016) points out disabled students typically achieve poorer results than non-disabled.

Law, Perryman, & Law (2013) suggest disabled learners are using the OU's Open Educational Resources (OER): OpenLearn (19% of sampled visitors report a disability); iTunes U (13% of visitors) and YouTube EDU (17% of visitors). Opening up Education[18], European Commission initiative proposed to enhance online and open learning:

> *Actions towards more open learning environments to deliver education of higher quality and efficacy and thus contributing to the Europe 2020[19] goals of boosting EU competitiveness and growth through better-skilled workforce and more employment.*

[17] Widening participation, https://www.hesa.ac.uk/news/07-02-2019/widening-participation-summary
[18] Opening up Education, http://www.openeducationeuropa.eu/en/initiative
[19] Europe 2020, http://ec.europa.eu/europe2020/index_en.htm

There is also scope to research how disabled learners are looking for lifelong learning: Tabuenca, Kalz, Ternier, & Specht (2016) identified daily practices of adult lifelong learners and how they can be supported with technology in and across contexts with the use of OER. MOOCs can play a role in that support. A study related to imparting digital skills to older learners recommended the use of MOOCs as a suitable approach for training and opportunities for re-skilling (Minocha et al., 2016). Dennen & Bong (2017) argued MOOCs are a good option for CPD because the open learning format and scalability can make access to well-designed professional learning affordable. Hamori (2017) supported the use of MOOCs in work environments, showing evidence that organisations which invested more in employee development are more likely to support the use of MOOCs. Calonge and Shah (2016) in their literature review showed the evidence from organisations that have working in partnership with MOOC providers, exploring how MOOCs could be offered at scale as interactive CPD.

2.4 The evolution of MOOCs

It is important to detail the changes in MOOCs since this research started, from when MOOCs were considered as an evolution of open education and could be considered OER, up to the current situation where the business models of the leading providers are moving towards a closed and paid for approach offering much less open content. Weller (2014, p. 89) anticipated this conflict of the MOOCs sustainable model:

> *No subject in educational technology in recent years has generated as much excitement amongst educational entrepreneurs and angst amongst established academics as MOOCs. If open access represents the clearest case for the argument that openness has been successful, then MOOCs are probably the best example of the second strand of this – that the battle for the future direction is now occurring.*

The word open included in the MOOC acronym has differed connotations with openness in OER. Open in MOOCs is related to the free access more than the 5Rs of openness: retain, reuse, revise, remix and redistribute (Wiley, 2014) (i.e. the content can be copied, used in a wide range of ways modified, combined with other resources and shared with others). Very few MOOCs initiatives consider the licensing of educational resources (Papathoma, Ferguson, Littlejohn & Coe, 2016). Therefore the definition of openness in MOOCs is related to the term open as it is for the OU (i.e. no formal qualifications are required, and no entry test is required): *"a policy of allowing anyone essentially to enrol in MOOCs regardless of their prior academic achievement"* (Wiley, 2015).

Wiley (2015) claims that MOOCs conceptually started in 2001 with the MIT OpenCourseWare initiative when MIT OCW made the materials used in teaching on-campus courses available to the public. In 2003, Wiley experimented with the use of blogs and aggregators to support distributed communications among students (Martindale & Wiley, 2004). In 2008, Siemens and Downes launched the course *"Connectivism and Connective Knowledge"* (Cormier, 2008). This course involved a large number of learners participating at the same time and also distributing the learning environment over several online spaces, giving participants the freedom to contribute to new content using a connectivist pedagogical approach (Downes, 2012). In 2011,

Thrun and Norving reached 160,000 learners with the course *"Introduction to Artificial Intelligence"* through Stanford University (Herman, 2012).

The MOOC phenomenon has grown steadily, and the need for architecture to support this level of massiveness was one of the factors that led to the creation of MOOC platforms (Sanchez-Gordon & Luján-Mora, 2016b). Some challenges were large-scale educational resources delivery, learning assessment, the need to develop a scalable pedagogy, and engaging learning experiences. Coursera, the first MOOC platform, was launched in 2012, and Harvard and MIT created edX (Weller, 2014). Since then, several MOOC platforms have appeared worldwide. The year 2012 was deemed *"Year of the MOOC"* (Pappano, 2012) as most major US universities signed up to one of the leading platform providers and launched their courses. MOOCs started all around the world: UNED Abierta and MiríadaX In Spain; in the UK the OU launched FL; in Germany it was Iversity; in Australia, Open2Study; in China, XuetangX; and FUN in France; each being platforms with millions of learners worldwide.

These MOOCs were pedagogically different from the early ones, which were driven by a constructivist approach; later MOOCs were centred on video instruction and automatic assessment. The distinction was made between cMOOCs for the early, connectivist type MOOCs and xMOOCs for the new, didactic models (Siemens, 2012). The classification of MOOC types has grown with many variations depending on the different pedagogical approach (Kesim & Altınpulluk, 2015; Porter & Beale, 2015).

A clear development seen in some of the leading platform providers is towards offering paid online learning programmes. For example, Udacity considers itself to not be producing MOOCs anymore (Warner, 2017). edX[20] offers several paid options: micro masters programmes, professional certificates and online master degrees. Coursera[21] terms its master programmes *"degrees and certificates"*, Udacity[22] *"nano degrees"* and FL[23] *"in-depth programs"* and *"online degrees"*. While, these providers have an extensive offer of free courses, in some cases these are now mostly self-paced (edX and Udacity). Nevertheless some platforms continue to offer MOOCs under entirely open-access policies such as Open2Study or MiríadaX, or the learning content is accessible after the course ends (including edX or Coursera). Some providers license educational resources with creative commons[24] (CC), allowing compliance with the 5Rs of openness (Wiley, 2015) such as NPTEL or Canvas. edX also operates in partnership with NGOs to provide open access MOOCs that adopt CC licenses (Buckler et al., 2014).

These aspects relate the approach of MOOCs within the Opening up Education initiative, enhancing the term *"openness"* including the concept of *"open accessibility"* (Jansen & Schuwer, 2015). Taking into consideration the previously mentioned business models changes, links remain between MOOCs and Open education. Several projects have addressed this area linking accessibility, open education and MOOCs. For

[20] edX Masters, https://www.edx.org/masters
[21] Coursera Degrees, https://www.coursera.org/degrees
[22] Udacity Nanodegrees, https://eu.udacity.com/nanodegree
[23] FutureLearn Programs, https://www.futurelearn.com/programs
[24] Creative Commons https://creativecommons.org/

example, in E-learning, Communication and Open-data: Massive Mobile, Ubiquitous and Open Learning (ECO e-learning)[25], an essential goal was the inclusiveness and accessibility by applying the concept of "*MOOCs for everybody*" as a pedagogical approach (Tejera & Osuna, 2013). MOOCs for Accessibility Partnership (MOOCAP)[26] project was focused on providing education on accessible design in ICT using MOOCs (Draffan et al., 2015). The project developed courses to teach how to create accessible media and content, such as websites, mobile apps and text-based files.

A further aspect apparent in the literature is the potential of MOOCs to increase their use in low and middle-income countries, as is apparent in the case of Latin America: Telescopio in Guatemala (Morales Chan et al., 2015), Veduca in Brazil (Stefano et al., 2016), or the use by Latin American universities of international platform providers for the expansion of their MOOCs in Spanish and Portuguese (Román Graván & Romero Tena, 2016). Examples of increased and innovative use of MOOC are available in China (Wang, 2017), in India (Nisha & Senthil, 2015), in Southeast Asia, Malaysia, Indonesia (Abas, 2015), in the Philippines (Bandalaria & Alfonso, 2015), and in Africa (Richards & Diallo, 2015).

Particular projects have also considered the use of MOOCs in teacher CPD such as TESS-India[27] and ROER4D [28] where MOOCs have been used for training in the Global South (Czerniewicz et al., 2017). Other examples are: MOOC on *"Mobiles for development*" (Venkataraman & Kanwar, 2015) by Commonwealth of Learning, and MOOCs on *"Climate change"* and *"World development"* (Jagannathan, 2015) by the World Bank Group (WBG). These different initiatives have demonstrated the role of MOOCs in expanding free access to online courses at a low cost, for that purpose, they have to meet the need to be accessible to their learners.

2.5 MOOCs within this thesis

In line with the concept of open presented in the previous section, the definitions that will be used for MOOCs and massiveness during this thesis are adopted from those provided by OpenUpEd[29] :

> *MOOCs are courses designed for large numbers of participants, that can be accessed by anyone anywhere as long as they have an internet connection, are open to everyone without entry qualifications, and offer a complete course experience online for free.*

In this definition by OpenUpEd, massiveness is further explained as where *"Number of participants is larger than can be taught in a campus classroom situation".* Massiveness implies that the design allows for a virtually unlimited number of learners, even if only a few turn up. The practical impact of operating at scale is brought out by the need to design for numbers big enough for course teams not to be able to provide individualised tutoring (Ferguson & Sharples, 2014). This definition makes it possible to accommodate different types of MOOCs and their pedagogies, giving room to online courses delivered on MOOC

[25] ECO eLearning, https://ecolearning.eu/
[26] MOOCAP, http://gpii.eu/moocap/
[27] TESS-India, http://www.tess-india.edu.in/
[28] ROER4D, http://roer4d.org/
[29] OpenUpEd, https://www.openuped.eu/

platforms, for example those from providers such as FL that have not claimed to be presenting MOOCs (Ferguson et al., 2017).

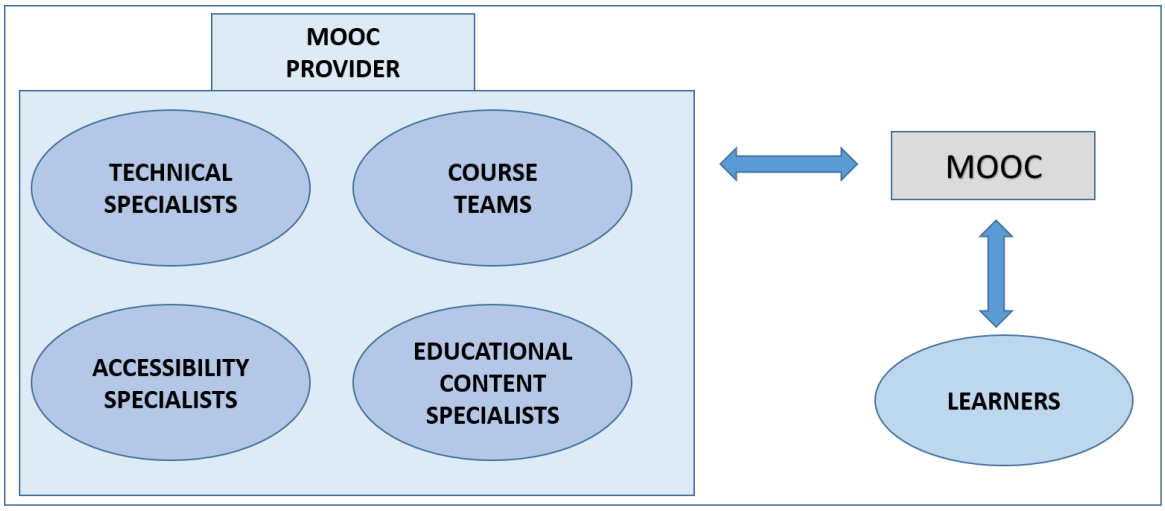

Figure 2. 1. MOOC providers and learners

In this thesis, two main groups of stakeholders related to accessibility in MOOCs have been identified, following similar structures for HE course production (Burgstahler, 2015; Seale, 2014). Figure 2.1 shows MOOC providers and learners; MOOC providers' profiles will be defined in **Section 4.3.1**. The definition of MOOC provider, including platform and course provider for this thesis is:

> *MOOC providers are those working from the side of the MOOC platforms, which can be platforms with different partners, such as FL or edX, or platforms that are part of the universities, such as the case of UNED Abierta (in-house) (referred as platform providers) and those that provide the courses, usually universities, but that can be any educational institution (referred as course providers).* [30]

Learners are defined based on Bray & McClaskey (2013, p. 14) definition of personalised learning:

> *The learner: knows how he or she learns best, self-directs and self-regulates his or her learning, designs his or her own learning path, has a voice and choice about his or her learning, is a co-designer of curriculum and learning environment, has flexible learning anytime and anywhere, has high-quality teachers who are partners in learning, uses a competency-based model to demonstrate mastery and is motivated and engaged in the learning process*

The definition of learner adapted to the MOOC context and that is used in this thesis is:

> *Learners can embrace in MOOCs the characteristics of learning anytime anywhere, direct their own learning, work at their own pace, develop own learning goals and monitors own process, achieve by active collaboration and feedback with others and design learning experienced based on interests.*

Table 2.1 summarises the 20 main platform providers considered in the scope of this thesis. The criteria to be part of the list are:

[30] When referring to "providers" it means "MOOC providers", otherwise "platform providers" or "course providers" is specified

1. **Representativeness**. The selection is between those who provide more than 50 MOOCs in both aggregators.

2. **Worldwide perspective**. It has been considered for the list, to offer a global perspective.

3. **Definition.** In this table have been included MOOC platforms which contain MOOCs following the MOOC definition proposed for this thesis.

4. **This research.** Providers interviewed for this research are included (**Section 4.4**); they all follow criteria 2 and 3 but not necessarily 1.

Subject to these criteria the table was then constructed based on information about MOOC providers from MOOC aggregators, Class Central[31] and CourseTalk[32], reviews on MOOCs around the world (Baturay, 2015), and the annual MOOC lists made by Class Central (Shah, 2016, 2017). As can be seen in **Table 2.1**, the dominant origins of platform providers resulting from this process are from the USA and Europe.

Table 2. 1. Platform providers

Provider	Country
Coursera	USA
edX	USA
XuetangX	China
Udacity	USA
Udemy	USA
Canvas	USA
Stanford Online - Lagunita	USA
Khan Academy	USA
NovoEd	USA
FutureLearn	UK
NPTEL	India
UNINETTUNO	Italy
Open2Study	Australia
Iversity	Germany
France Université Numérique (FUN)	France
Miríada X	Spain
UNED Abierta	Spain
Telescopio	Guatemala
Uab iMOOC UAB	Portugal
ECO eLearning	EU

The diversity of providers represented in **Table 2.1** is also reflected in each provider having different structures for their platforms. Iniesto & Rodrigo (2016) defined a range of structures and components to be considered:

- **Access to the platform.** Access to the MOOC platform through a registration and sign-in process.

- **MOOC Platform.** MOOC components to include assignments, discussions and evaluations.

- **Learner information.** The user profile includes data on learner preferences.

[31] Class Central, https://www.class-central.com/
[32] CourseTalk, https://www.coursetalk.com/

- **Educational resources**. The educational content available within the platform as educational resources in text-based or video format or outside the platform in social media (i.e. third-party software).

For clarity in this research, the structure used is based on that from FL, which sets out steps that include all the interactions learners perform inside a course [33]. These steps can include articles (to convey information), discussions, videos, audios, peer review, quizzes, tests and exercises. The derived structure presented in **Table 2.2** was then adapted to take into account the other leading providers and their terminology (e.g. forums instead of discussions, assignments instead of exercises), and is influenced by previous research (Iniesto & Rodrigo, 2016). It differentiates platform and course structures including their definitions. This structure is used in this thesis to analyse interview data (**Sections 4.5.2 and Section 6.4.2**), in the accessibility audit (**Section 7.3.3**) and the to support the triangulation of outcomes (**Section 9.2**).

Table 2.2. MOOC structure in the context of the thesis

General structure	MOOC structure	MOOC components	Definition
MOOC platform	Platform design and access	• Registration and sign in • MOOC search • Personal profile	The design of the platform, the software that hosts the MOOCs and access to it.
MOOC	Course main page	• Homepage • Syllabus	Homepage with learning goals, practical information and the workload schedule
	Educational resource	• Article • Video • Podcast (audio) • Images • Text-based files • Third-party software	All the educational resources that may include articles, videos, podcasts, images, text-based files and third-party software.
	Discussion	• Forum \ Discussion	Forums or discussions which can have their own space or be embedded in the educational resources.
	Assignment	• P2P • Individual assignment	P2P assignments (peer to peer, reviewed between peers) or individual assignments.
	Test and Quiz	• Test • Quiz	Test are scored and have implications to get a certificate; quizzes are designed to provide feedback to the learner.
Both	Help	• Support • Helpdesk	Report and feedback on barriers to learning.

2.6 The perspectives of MOOC providers

There is limited research on course team experiences in MOOCs and how they are trained and interact with MOOC learners (Haavind & Sistek-Chandler, 2015; Papathoma, 2019), in particular little is known in the literature in how MOOC providers develop their platforms or courses by taking into account the needs of disabled learners.

Smith, Dowse, Soldatic, & Kent (2017) provide an overview of the process of developing a MOOC that includes accessibility from the experiences of educators involved, authors aimed to explore what their named "*Disability pedagogy"* in MOOCs. Authors reflected that much of the work on MOOC development

[33] FL steps, https://www.futurelearn.com/using-futurelearn

and design is very ad hoc, showing how difficult it is to get development teams working together. It is relevant to consider a characteristic of MOOCs is the high degree of interactivity that facilitates and reinforces the bidirectional communication between learners, and with course teams (Wong et al., 2015). In MOOCs the role of the course team changes, being less prominent than it is in traditional online learning (Papathoma, 2019; Ross et al., 2014). This role is updated, closer to the idea of pedagogical mediation, playing the role of a "*facilitator*" of the learning processes (Rodrigo, 2014).

The limited range of existing research focused on accessibility in MOOCs leads to the first research question:

RQ1. How do MOOC providers cater for disabled learners?

An exciting feature of MOOCs is their potential to widen access to education. This remains even as the leading providers have changed their business models because there are still initiatives that aim to remain open and with low cost to learners (as explained in **Section 2.5**). Learning via MOOCs requires a significant commitment from the learner, aptitude for research and analysis, reflexive capacity along with personal autonomy (Littlejohn et al., 2016). This motivation of learners while participating in MOOCs is explored in the following section.

2.7 The perspectives of disabled learners

Some of the well-known limitations in MOOCs are the low engagement of learners undertaking MOOCs (Christensen et al., 2013; Gore, 2018; Grainger, 2013) and the high dropout rates (Hood & Littlejohn, 2016). It is difficult to know the actual number of learners taking part in MOOCs (Guo & Reinecke, 2014); however, the definition of success needs to relate to the learner and finishing the MOOC is not necessary the goal for all learners (Liyanagunawardena, Parslow, & Williams, 2017). The motivations of online learners are diverse. Some learners at university level show particular interest in *"having a full-time job"* (Ilgaz & Gulbahar, 2017) while using online environments for social interaction or leisure (Serdyukov & Serdyukova, 2015).

Particular research on learners perspectives participating in MOOCs includes Littlejohn et al. (2016) who investigated via surveys and interviews that learners' motivation was different depending on their self-regulated learning experience. Shapiro et al. (2017) in a similar mixed methods approach with 2 MOOCs, suggested the educational background of the learners influenced their motivation and frustration. Watted & Barak (2018) research showed a significant number of the learners who completed their MOOC were looking for *"career development"*, *"personal and educational benefits"* but motivations differ depending on demographic factors such as age, personal aspects and affiliation to a university. Sablina, Kapliy, Trusevich, & Kostikova (2018) in a sample of 30 MOOC learners showed the inconsistency with the measurement of success used by platforms providers, learners placed value on acquiring *"new knowledge"*, *"increased self-confidence"*, and *"social connections"* removing the focus on course completion and certificate payment. FL has included categories to classify their learners in three archetypes: *"work and study"*, *"personal life"* and *"leisure"* (Walker, 2018). These studies show that MOOC learners are diverse, learners have different motivations and completion is not the aim of all of them.

The inclusion of accessibility aspects has been investigated via survey data by Liyanagunawardena and Williams (2016) with older learners, indicating MOOCs can help to tackle loneliness. Uchidiuno, Ogan, Yarzebinski, & Hammer (Uchidiuno et al., 2018, 2016) conducted interviews and surveyed learners who were studying English as a Second Language (ESL), showing their need for individualised tools. While Liu, Kang, & McKelroy (2015) research with learners was not oriented to accessibility aspects, authors highlighted the importance of good MOOC design because difficult navigations and unintuitive interface affected the learning experience and perception of the course negatively. In the same sense, Park, Jung, & Reeves (2015) reinforced the idea MOOCs can be a challenging experience and should be as flexible as possible to meet the diverse needs of learners.

In the case of MOOCs, there is a lack of studies that investigate the number of disabled learners taking part and their motivations; hence, the second research question is:

RQ2. What are the motivations of disabled learners when taking part in MOOCs?

The pedagogical and visual design of MOOCs, their information architecture, usability and interaction design could be having a negative impact on learners' engagement (Liyanagunawardena Tharindu, Parslow, & Williams, 2014). There are barriers such the limited access to the internet in some countries, the use of the language and accessibility barriers that can affect the learners' experience (Sanchez-Gordon & Luján-Mora, 2015a). The accessibility aspects of MOOCs will be described in the next section.

2.8 Accessibility in MOOCs

To begin to understand issues in MOOC accessibility, there is a need to draw on research on accessibility in OER and Learning Management Systems (LMSs). Law, Perryman, & Law (2013) reflect on the need to address accessibility features of platforms and repositories where OERs are deposited, and that institutional repositories should be designed with accessibility in mind. European Unified Framework for Accessible Lifelong Learning (EU4ALL)[34] was a major collaborative project (Boticario et al., 2012; McAndrew et al., 2012) that highlighted the importance of adapting online learning resources for all and stressed the need to make accessible content available. Brahim, Khribi, & Jemni (2017) indicated the lack of accessibility awareness within the repositories and platforms that host OERs. Problems regarding accessing LMS and also difficulties for learner interaction with educational resources have been widely reported (Acosta & Luján-Mora, 2016; Alahmadi & Drew, 2016; Iglesias et al., 2014; Rodríguez et al., 2017).

MOOCs are presented using Web technologies (like LMSs), which is why MOOC platforms represent a domain in which the Web accessibility has broad application. In this sense, Web accessibility initiative[35] (WAI) promotes accessibility through standards-related such as Web Content Accessibility Guidelines[36] (WCAG). The particularity of MOOCs is that they are based on collections of visual and audio resources; they

[34] EU4ALL, http://eu4all-project.atosresearch.eu/
[35] Web accessibility initiative, https://www.w3.org/WAI/
[36] Web Content Accessibility Guidelines, https://www.w3.org/WAI/standards-guidelines/wcag/

are made up of educational resources, assignments, quizzes and test, all of which are integrated into the courses.

Platform providers are responsible for the user experience (UX) in the courses: the way the content is organised, and the components are structured. Course providers are involved in the learning design, learners must be able to carry out tasks such as reading articles, watching videos, carrying out their assignments, accessing the discussions, and communicating with other learners and the course team. The MOOC learning design can be determined by the platform as some of its characteristics can be very rigid not allowing to design certain activities. MOOC platforms and courses have a variety of components that do not always share consistency: messages in a forum, feedback in quizzes, design of videos, and the possibility of downloading text-based files in a variety of formats. More problems may arrive in the processes of participation with other learners while collaborating in assignments or discussions.

Videos are a key element in MOOCs providing subtitles, adaptation to sign language, alternative content for audio-visual resources, recordings with audio description, are not easy to achieve, even when there are comprehensive guidelines (Sánchez, 2013). As regards, text-based files like PDFs are very common for presenting support to the content of the videos as handouts, but in assignments, the handing in of the text-based file is usually in Word format in which the accessibility guides must also be followed (Moreno et al., 2014).

In conducting the literature review, it has been observed that there has been limited research focused on accessibility within MOOCs. Research papers have been clustered into two main groups (as shown in **Table 2.3**) organised by the studies applied:

1 **Report papers**. This group involves practical papers that show research in accessibility evaluations including one or several methods.

2 **Analytical papers**. This group includes theoretical papers that may consist of frameworks, legal perspectives, or different proposals to improve accessibility.

Table 2. 3.Report and analytical papers

	Categories	Authors
Report papers	Mixed methods evaluations	(Al-Mouh et al., 2014; Bong & Chen, 2016; Ferati et al., 2016; Park et al., 2015)
	Accessibility evaluations	(Akgul, 2018; Calle Jimenez et al., 2014; Martin et al., 2016; Sanchez-Gordon & Luján-Mora, 2013b, 2016c; Sanderson et al., 2016)
	User-based evaluations	(Bohnsack & Puhl, 2014; Fernández et al., 2016; Królak et al., 2017; Rizzardini et al., 2013)
	UX evaluations	(Espada et al., 2014; Young, 2014; Yousef et al., 2015)
Analytical papers	Literature Review	(Sanchez-Gordon & Luján-Mora, 2017)
	Interaction with stakeholders in MOOCs	(Liyanagunawardena & Williams, 2016; Smith et al., 2017; Uchidiuno et al., 2016, 2018)
	Legal challenges applied to MOOCs	(Anastasopoulos & Baer, 2014; Baker et al., 2012; Singleton & Clark, 2013)

	Categories	Authors
	MOOC accessibility improvement proposal	(Bain et al., 2013; Cinquin et al., 2018; González & Rodríguez, 2016; Gupta & Fatima, 2016; Robles et al., 2016; Rodrigo, 2014; Rodríguez-Ascaso & Boticario, 2015; Sanchez-Gordon & Luján Mora, 2014; Sanchez-Gordon & Luján-Mora, 2013a, 2015a, 2016a; Xiao et al., 2015)
	Profiling learners' needs	(Sanchez-Gordon & Luján-Mora, 2015b, 2016b)
	MOOCs as an approach to teaching accessibility	(Draffan et al., 2018, 2015; Gay et al., 2017; Gilligan et al., 2018; Kelle et al., 2015; Orero et al., 2018; Osuna-Acedo et al., 2017)

Limited research and mainly individual approaches without a methodological consistency, indicate that it there is scope to investigate accessibility of MOOCs; hence, the third research question is:

RQ3. How can MOOCs be made accessible for disabled learners?

This research question has several aspects of being covered in order to be answered: to understand the accessibility in current MOOC platforms and courses and to identify procedures to address accessibility barriers. These two aspects are investigated in the following two subsections.

2.8.1 The current state of accessibility in MOOCs

The papers previously identified discuss the current state of accessibility evaluation. **Table 2.4** shows the different research studies, the samples and the accessibility evaluation methods (AEMs) included. Martin et al. (2016) included a large sample of MOOC platforms covering the results of three different automatic accessibility tools. Al-Mouh et al. (2014), Bong & Chen (2016) and Ferati et al. (2016) reported studies applying heuristic accessibility evaluation using automatic evaluation tools and including learners in their evaluations. Other types of evaluations included users via testing groups as it is the case of Bohnsack & Puhl (2014) with visually impaired learners. Espada et al. (2014) used a miscellanea of different types of evaluations using automatic tools for usability; Young (2014) and Yousef et al. (2015) focused on heuristic usability evaluations. The only study that included online survey data to assess the accessible design of a MOOC was Rizzardini et al. (2013).

Table 2.4. Report papers (by sample, standard and AEM)

Authors	MOOC Sample	Standard	AEM
(Akgul, 2018)	3 MOOCs (Anonymised)	WCAG 2.0	Expert evaluation
(Al-Mouh et al., 2014)	1 platform provider - 10 MOOCs	WCAG 2.0	Expert evaluation and 2 blind users
(Bohnsack & Puhl, 2014)	5 platform providers - 1 MOOC per provider	WCAG 2.0	2 blind users
(Bong & Chen, 2016)	1 platform provider - 1 MOOC	WCAG 2.0	Expert evaluation and 6 old users
(Calle Jimenez et al., 2014)	Coursera (1 MOOC)	WCAG 2.0	Expert evaluation
(Espada et al., 2014)	5 platform providers - 1 MOOC per provider	W3C Best Practices Usability.gov	Expert evaluation
(Ferati et al., 2016)	1 platform provider - 2 MOOCs	WCAG 2.0 IBM Heuristics	Expert evaluation and 2 blind users
(Fernández et al., 2016)	Proof of concept	WCAG 2.0	10 old learners and 10 control group
(Królak et al., 2017)	1 platform provider - 1 MOOC	WCAG 2.0	7 visual impaired users
(Martin et al., 2016)	8 platform providers - 1 MOOC per provider	WCAG 2.0	Expert evaluation
(Park et al., 2015)	3 platform providers - 1 MOOC per provider	UDL	2 experts and 4 visual impaired users
(Rizzardini et al., 2013)	1 platform provider - 1 MOOC	WCAG 2.0	Survey data

Authors	MOOC Sample	Standard	AEM
(Sanchez-Gordon & Luján-Mora, 2013b)	1 platform provider - 1 MOOC	WCAG 2.0	Expert evaluation
(Sanchez-Gordon & Luján-Mora, 2016c)	1 platform provider	ATAG 2.0	Expert evaluation
(Sanderson et al., 2016)	1 platform provider - 1 MOOC	ATAG 2.0	Expert evaluation
(Young, 2014)	1 platform provider - 2 MOOCs	Self-reported	Expert evaluation
(Yousef et al., 2015)	Proof of concept	Conole's dimensions	50 questionnaires

In these studies the samples are reduced to evaluate a single MOOC, there is a predominance of using automatic tools to conduct the evaluations instead of combining them with experts for manual evaluations (Al-Mouh et al., 2014; Bong & Chen, 2016; Calle Jimenez et al., 2014; Espada et al., 2014). The studies presented tend to involve vision impaired learners as participants; these participants usually come from a single organisation (Al-Mouh et al., 2014; Bohnsack & Puhl, 2014; Bong & Chen, 2016; Ferati et al., 2016; Królak et al., 2017; Park et al., 2015). The majority of evaluations are based on WCAG, e.g. (Akgul, 2018; Al-Mouh et al., 2014; Bohnsack & Puhl, 2014; Bong & Chen, 2016; Calle Jimenez et al., 2014; Fernández et al., 2016; Królak et al., 2017; Martin et al., 2016; Rizzardini et al., 2013; Sanchez-Gordon & Luján-Mora, 2013b).

For a better understanding of the accessibility barriers in MOOCs, the methodology should try to cover a combination of different accessibility evaluation methods (AEMs) and a broader set of disabled learners. The first sub-question for **RQ3** which aims to understand how MOOCs can be made accessible for disabled learners is:

RQ3a. What is the current state of accessibility of MOOCs?

There is still a need first to identify the accessibility barriers in MOOCs and find out ways to address them as it is detailed in the following subsection.

2.8.2 Identifying and addressing accessibility barriers

The analytical papers included in this literature propose frameworks, legal and technical proposals to improve accessibility in MOOCs. **Table 2.5** shows the different categories and the main findings. Baker et al. (2012), Singleton & Clark (2013) and Anastasopoulos & Baer (2014) focused on the increasing number of legal challenges that HE institutions must address to offer equal access for disabled learners indicating the legislation and standards around accessibility and their lack of use in MOOC development. The rest of the papers aim to integrate accessibility aspects in the technological infrastructure of MOOCs. Sanchez-Gordon and Luján-Mora (2013a, 2015a) researched accessibility considerations of MOOCs for ESL. Rodríguez-Ascaso & Boticario (2015) proposed a MOOC framework consisting of accessibility services. Sanchez-Gordon & Luján-Mora (2015b) developed a three-layer architecture to enhance accessibility.

Table 2. 5. Analytical papers (by categories and main findings)

Categories	Authors	Main findings
Interaction with	(Liyanagunawardena & Williams, 2016)	Data via a pre-course survey for ten courses on the FutureLearn platform to show evidence that learners in their old age are participating in MOOCs

Categories	Authors	Main findings
stakeholders in MOOCs	(Uchidiuno et al., 2018, 2016)	ESL speakers have a variety of motivations for taking online courses that are not captured in current surveys, which implies that current one-size-fits-all approaches to increasing MOOC accessibility may not be effective
	(Smith et al., 2017)	Provides an overview of the process of developing a MOOC from the experiences of educators involved
Legal challenges applied to MOOCs	(Baker et al., 2012)	Questions to ensure that the process is equitable implying socioeconomic status, technology and cross-cultural collaborations
	(Singleton & Clark, 2013)	There are an increasing number of legal challenges that higher education institutions have to ensure to offer equivalent access for disabled learners
	(Anastasopoulos & Baer, 2014)	If the MOOC courses are inaccessible to learners with certain disabilities, the institutions and the platform providers may be found to have violated legislation
MOOC accessibility improvement proposal	(Bain et al., 2013)	The development of a MOOC that encapsulates a universal design approach that integrates the use of speech recognition to create accessible course media
	(Sanchez-Gordon & Luján-Mora, 2013a, 2015a)	Accessibility considerations of MOOCs for ESL learners in blended learning and flipping the classroom environments
	(Sanchez-Gordon & Luján Mora, 2014)	Two categories of accessibility requirements: for personal and for non-personal disabilities
	(Rodrigo, 2014)	Specifics strategies regarding the achievement of accessibility in all aspects of the overall MOOC platforms and especially in Language MOOCs
	(Rodríguez-Ascaso & Boticario, 2015)	MOOC framework consisting of services, standards and quality procedures related to accessibility
	(Xiao et al., 2015)	Explores MOOCs learning resources design theories and proposes a model and principles for MOOCs learning resources design
	(Robles et al., 2016)	Explores alternative ways to enhance the accessibility of online-courses' interfaces for blind learners.
	(González & Rodríguez, 2016)	Example of how designers can make more accessible MOOCs' interfaces.
	(Gupta & Fatima, 2016)	The development of MOOCs for Hearing Disabilities
	(Ngubane-Mokiwa, 2016)	Recommendations to make MOOCs more accessible for learners with visual impairments
	(Cinquin et al., 2018)	The creation of a MOOC player offering a set of accessibility features that users can alter according to their needs and capabilities
Profiling learners' needs	(Sanchez-Gordon & Luján-Mora, 2015b)	Three-layer architecture to extend the Open edX[37] platform to enhance the accessibility by adapting course content, and which is personalised to learners needs, preferences, skills and situations

These papers argue the need to enhance accessibility in MOOCs by adding layers, services and profiling options. These approaches are not necessarily considering those layers when the platforms or courses are designed. It seems challenging to profile learners when there is a lack of research on understanding what they like or prefer. Analytical papers offer a miscellanea of different initiatives to improve accessibility. Apart from Cinquin et al. (2018), there is a lack of participatory design processes (PD) empowering disabled learners to participate in the design (Cocks & Cockram, 1995). There isn't a holistic approach to identify and improve accessibility; the second sub-question for **RQ3** is:

RQ3b. How can accessibility barriers in MOOCs be identified and addressed?

A study by (Straumsheim, 2017) that assessed the overall accessibility of content in online courses identified how slow the progress of making accessible educational resources has been over the last years, making those materials *"only slightly more accessible"*. This study showed the value of an automated process to help quantify the issues that need to be addressed; at the same time, the approach limits the

[37] Open edX, https://open.edx.org/

outcomes to content-related issues, rather than those of design. There is a need to provide processes to help to make MOOCs accessible for disabled learners.

2.9 Research questions

The research questions are based on the limitations and gaps identified in the literature review, there is a lack of knowledge from what MOOC providers do for accessibility and what disabled learners expect from MOOCs. As Seale (2014) argues, there a need to understand the multiple viewpoints of stakeholders in accessibility practice:

- Such as those of course providers who create educational resources and facilitate learning, and of platform providers who develop and maintain platforms. It is therefore essential to identify how these stakeholders can be involved in achieving accessibility in MOOCs and cater for disabled learners. Research with MOOC providers is needed to capture their practices and constraints of integrating accessibility.

- Taking into account that disabled learners have limitations while accessing and using the different types of technology that they come up against (Gould et al., 2015), the appearance of the digital divide (Van Deursen & Helsper, 2015), and not forgetting the relevance that massiveness has in MOOCs (Gasevic et al., 2014). The motivations and barriers of the learners who have accessibility requirements need to be researched.

- Rodríguez-Ascaso & Boticario (2015) and Rodrigo & Iniesto (2015) argue the need to provide a holistic vision for creating accessible MOOCs. Several AEMs are needed to evaluate MOOCs, to provide indicators of the accessibility barriers and to develop processes to be addressed.

The research questions are as follows:

- **RQ1**. How do MOOC providers cater for disabled learners?
- **RQ2**. What are the motivations of disabled learners when taking part in MOOCs?
- **RQ3**. How can MOOCs be made accessible for disabled learners?
    - **RQ3a**. What is the current state of accessibility of MOOCs?
    - **RQ3b**. How can accessibility barriers in MOOCs be identified and addressed?

2.10 Conclusions

This chapter has highlighted several gaps in the research: there is a lack of knowledge about how MOOC providers deal with accessibility and consider disabled learners in their platforms and courses. Previous research has not focused on understanding the motivations of disabled learners participating in MOOCs. Accessibility in MOOCs has been investigated, but there is not a clear image of their current state or provision of design approaches to develop accessible MOOCs. The next chapter will draw the overall methodology used in this research.

3. Methodology

This chapter outlines the methodology for this research project.

3.1 Introduction

The research has taken a study-based approach; each study having its own research design, and methods of data collection and data analysis. The results from the studies are then related to each other to provide an overall conclusion and indications for further work. The methodology developed through consideration of the epistemology (**Section 3.2**) leading to the research design explained in **Section 3.3.** The research methodology of interviews, online surveys, an accessibility audit and other methods is detailed in **Sections 3.4 - 3.7**; **Section 3.8** addresses the ethical considerations of this project. **Section 3.9** outlines the timeline of the project.

3.2 Epistemology

Epistemological paradigms have been considered to design the methodology for this doctoral research. The contrasting stances defined by Twining, Heller, Nussbaum, & Tsai, (2017, p. 2) were the two different paradigms that were initially considered: *"there is one objective reality, therefore, there is one true explanation"* and *"there are multiple realities, meaning is culturally defined"*. The selection of the epistemological paradigm defines the methodology to be used, which, following the previous stances, can be quantitative (positivist) or qualitative (constructivist) (Twining, 2010). In social science research, there are several views linked to qualitative or quantitative research methodologies and methods (Crotty, 1998). At one extreme positivism (quantitative) claims there is only one truth, and follows a quantitative approach that reality is measurable with reliable tools (Taylor & Medina, 2011). While constructivism on the other side employs qualitative approaches to claim that there is no one single truth because group membership constructs truth and reality must be interpreted through the members (Fosnot & Perry, 1996).

The identification of appropriate methods for this doctoral research design has been shaped by the fact that the research involves vulnerable groups and associated ethical considerations (**Section 3.8**). The critical paradigm emphasises that there isn't a single truth because this truth is built on society; therefore, is socially constructed and interpreted (Bryman, 2012). Critical research is deliberately critical with the purpose to change society; this type of research encourages participatory or action research (Seale et al., 2014). Given the agendas of accessibility and widening the participation in HE, students' aspirations can sometimes be interconnected with complex personal situations and multiple disability identifications produced within universities (Burke, 2013). Further, for transforming education institutions for widening participation, it is imperative to address embedded structural inequalities across disability (Burke, 2009). In the context of this doctoral research, the MOOC production (course providers) highlighted that the design of MOOCs is often linked to the internal accessibly processes of the HE institutions. These institutions face different realities when producing online educational resources (i.e. they have different skills, experience and knowledge as compared to face-to-face settings) (Rodrigo et al., 2016). The case of platform providers is not different; some reuse software designed for different purposes for MOOC delivery (e.g. iMOOC or MiríadaX), develop

new software (e.g. FL or edX) or reuse MOOC designed software for different platforms (e.g. UNED Abierta or FUN).

While universal design (UD) encourages positive consideration of disabled learners, a further approach is to view the design process as one of designing for diversity. All learners have diverse needs and, in practice, the approach leads to a model of alternative solutions around a core learning design. The preferred design approach as defined in **Section 2.2** is inclusive design; it seeks to augment a central design by adding in a consideration of particular learner groups so that they are included, potentially through an alternative design rather than the single design (Clarkson et al., 2013). Inclusive learning design aims to avoid the trap of looking at the technology that is needed for implementation by considering learning design in terms of learning goals, a model of pedagogy, and pattern of interactions with those involved (Toetenel & Bryan, 2015). This approach is aligned to that implemented at the OU in its aims to "*strike the right balance between digital augmentation and the human element in providing accessible services"* (McAndrew et al., 2012, p. 16).

The epistemological paradigm of pragmatism observes that there is not a single truth, the truth is continuously changing and needs to be argued and reinterpreted considering new circumstances, and reality is discovered by the methods (Badley, 2003). This paradigm recommends the use of mixed-methods methodology (Creswell & Clark, 2017) which can involve use of both quantitative and qualitative methods (Mittelmeier, 2017). Pragmatism, therefore, allows to investigate the several realities of a diverse group of stakeholders and their diverse needs. For that reason, and as it will be detailed in the next section, the pragmatic methodology selected for this doctoral research includes qualitative, quantitative and Human-Computer Interaction (HCI) methods.

3.3 Research design

The pragmatic approach suggested above is demonstrated in the literature on MOOC research. Liyanagunawardena, Adams, & Williams (2013) pointed out that in the initial stage of MOOCs, the period from 2008-2012, the majority of research has used multiple methods for data collection: primarily online surveys; also, via interviews, focus groups and by collecting platform data/analytics. Gasevic et al. (2014) indicated the use of mixed methods is a good match for research in MOOCs, by recognising the complexity of massiveness and openness of MOOCs. Veletsianos & Shepherdson (2016), in a review focused on 2013-2015 literature, indicated researchers favoured quantitative approaches with survey data and secondary data collected via automated methods, and that qualitative methods informed few studies. Joksimović et al. (2018) in their systematic literature review pointed out the lack of generalisability of current results in MOOC research, which was also apparent in the discussion on accessibility in **Section 2.8**. As the literature reviews indicates and Evans, Baker, & Dee (2016) suggest, research on MOOCs needs to focus on research approaches across different domains and multiple methods.

In this doctoral research design, research methods that require opinions from stakeholders have been included: qualitative studies with MOOC providers and disabled learners facilitate understanding of their point of view (**RQ1** and **RQ2**) and the way accessibility of MOOCs can be improved (**RQ3**). Quantitative

studies were used to understand the demographics and motivations of learners (**RQ2**) and to draw out initial ideas on barriers (**RQ3**). A systematic tool called the MOOC accessibility audit based on HCI's heuristic evaluation method was developed in this project and is detailed in **Section 3.6**. The audit tool involved expert-based evaluation to detect accessibility barriers (**RQ3**). The mapping between research questions and methods is shown in **Figure 3.1**.

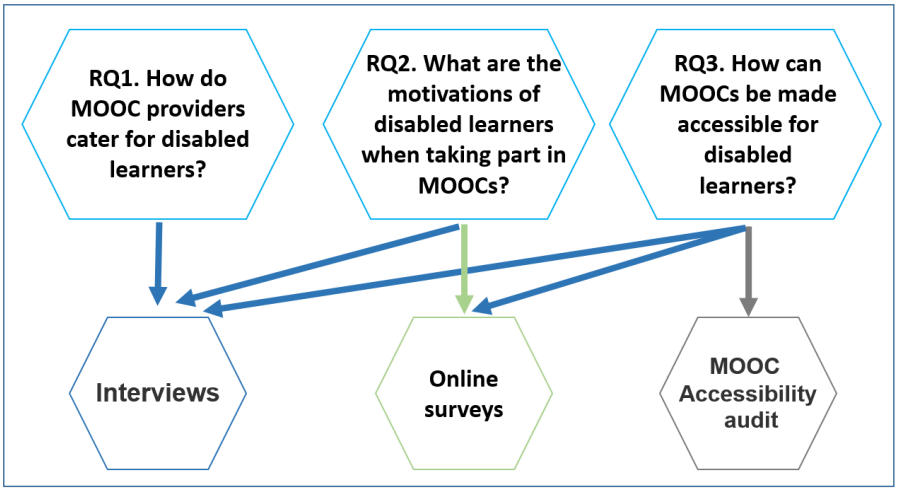

Figure 3. 1. Research questions and methods

The research design has involved three main research methods: interviews, online surveys and the MOOC accessibility audit in three studies. The studies have been applied at various stages of the research process (**Figure 3.2**):

- **Study A.** Interviews were conducted with 26 MOOC providers such as software developers, accessibility managers, inclusion designers, instructional designers, course editors and learning media developers (**RQ1** and **RQ3**) (**Chapter 4**).

- **Study B.** This study involved comparative quantitative pre- and post-course survey data involving learners who had participated in 14 FL MOOCs (with 29K and 5K respondents) and interviews with 15 FL disabled learners to capture their experiences with MOOCs (**RQ2** and **RQ3**) (**Chapters 5 and 6**).

- **Study C.** An accessibility audit was devised, validated and used to evaluate four MOOCs: FL, edX, Coursera and Canvas. This audit comprises of 4 components: accessibility, user experience (UX), quality and learning design; 10 experts were involved in the design, application and validation of this audit (**RQ3**) (**Chapter 7 and 8**).

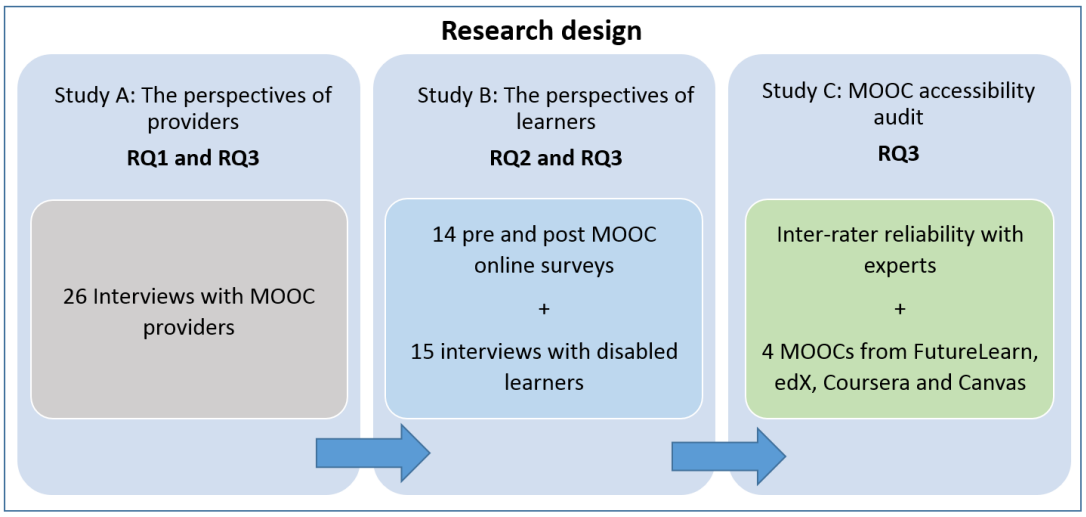

Figure 3. 2. Studies in this research

RQ3 is answered through the three complementary studies. The findings from user-based studies are reinforced by the results from the audit which revealed further barriers. **RQ3** will be addressed in each study (**Sections 4.7, 5.8, 6.8**) and consolidated in **Section 8.5** when discussing Study C.

As a consequence of having different samples when merging research methods (Creswell et al., 2008) the combination of methods allowed triangulation, to bring complementary information (Hammersley, 2008) together and for checking validity (Robinson et al., 2007). The sampling processes for the studies have been influenced by the pragmatic approach of this research, that is, trying to understand different truths. The profiles of the MOOC providers, disabled learners, and the MOOCs selected for the surveys and the accessibility audit have allowed a wide variety of disabilities and HESA subjects to be covered to give a holistic perspective (Rodrigo & Iniesto, 2015).

The research in this thesis has aimed to provide a basis for improvement in the MOOC development processes to enhance the accessibility in MOOCs (**Sections 9.3** and **9.4**). This research design acknowledges that addressing accessibility is an ongoing process which involves stakeholders continually reviewing, evaluating and improving practice (Bell, 2010; Denscombe, 2009) (**Section 9.6**). The following sections will describe the three research methods used in this research: interviews (**Section 3.4**), online surveys (**Section 3.5**) and the MOOC accessibility audit (**Section 3.6**).

3.4 Interviews

Studies A and B have involved interviews. Semi-structured interviews allowed interviewees to expand their thoughts and experiences through a set of predefined variable questions (Ayres, 2008; Bloor & Wood, 2006). Semi-structured interviews give freedom to interviewees to express themselves and have control over the themes being discussed (Barriball & While, 1994). The specifics of the study design data collection and analysis from these studies are discussed in **Sections 4.3 - 4.6 and 6.2 - 6.4**.

In Study A, interviews have involved MOOC providers and MOOC researchers. The aim was to explore the perspectives of platform and course developers on the importance of accessibility of the MOOC

environment. The data from this study was useful to understand how to approach the next steps in this research. Interviewing individuals involved in MOOC development helped to understand how they cater for disabled learners (**RQ1**), and the approaches they use to design accessible MOOCs (**RQ3**).

Study B has involved disabled learners who had participated in learning via MOOCs. Learners were a useful source of data to explore the accessibility barriers and their solutions in using the technology and the learning designs they come up against (Järkestig Berggren et al., 2016) when interacting with MOOCs. The data from the interviews helped to understand their motivations (**RQ2**), the current accessibility barriers they have found, how they reacted to them, and their suggestions for desired solutions (**RQ3**).

In Study B, it was essential to understand the individual situations learners have when working with MOOCs and to consider their varied contexts (Merriam & Tisdell, 2015). For that reason, a Person-Centred Planning (PCP) approach has been used. PCP is a combination of approaches designed to empower disabled people to make their own choices and decisions (Lewis & Sanderson, 2011). The idea of PCP is to facilitate the expression of interests by placing the individual at the centre of the planning process. The learner is the individual who is the real expert in their own needs and who is best positioned to enable positive development. PCP is a learner-centred approach allowing learners to choose their preferred way to communicate in the interviews and influence their content through a pre-questionnaire prior to semi-structured interview (Wilson et al., 2016).

Thematic analysis (Lapadat, 2009) was applied to supporting the analysis of exploratory interviews in this research area of MOOC accessibility where there has not been significant qualitative research. Heterogeneity of samples further reinforced the choice of the thematic analysis method (Thomas, 2006) for analysis of the interview data. The different phases used to analyse the interviews can be seen in **Table 3.1** following Braun & Clarke (2006, p. 87).

Table 3. 1. Phases of Thematic Analysis

Phase	Description of the process
1. Familiarising yourself with your data	• Transcribing data • Reading the data, noting down initial ideas
2. Generating initial codes	• Coding features of the data in a systematic way across the entire data set
3. Searching for themes	• Collating codes into potential themes, gathering all data relevant to each potential theme
4. Reviewing themes	• Checking in the themes work about the coded extracts and the data set • Generating a thematic map of the analysis
5. Defining and naming themes	• Refine each theme, generating clear definitions and names for each theme.
6. Producing the report	• Selection of compelling extract examples • Relating back to the analysis of the research question • Producing a scholarly description of the analysis generating clear definitions and names for each theme

The results of thematic analyses produced were validated with a member of the research team: 18.48% (Study A) and 11.45% (Study B); these results are as per percentage in the literature (between 10% and 15%) (Strijbos et al., 2006; Strijbos & Stahl, 2007) (**Sections 4.5.3** and **6.4.3**).

3.5 Online surveys

Study B employed online surveys as a source of secondary data as a precursor to interviews. Data from past OU MOOCs in FL have been analysed which helped to provide insights into who is participating in MOOCs and to derive preliminary insights into their motivations (**RQ2**) and possible barriers in usage of MOOCs (**RQ3**). The OU has a standard pre- and post-course survey included in the MOOCs in FL. These surveys include questions related to disabilities and enquire about educational interests. The specifics of the study design, data collection and analysis are detailed in **Sections 5.4-5.6**.

Perryman & De Los Arcos (2016) used a comparative study approach to indicate differences between disabled and non-disabled learners' use of OER. In that case, authors designed the surveys for their study. However, in Study B, the online surveys were not designed by the researcher but they were used to:

1. Carry out a comparative analysis between disabled and non-disabled learners and to gain some preliminary insights related to the research questions (Mills, Van de Bunt, & De Bruijn, 2006).

2. Develop a profile of those learners to be contacted for the interviews drawing on the contact and consent provided at the time of completion of the online surveys.

Due to the nature of the data a descriptive approach was used to analyse the online surveys (Sapsford & Jupp, 2006) to uncover the information on disabled and non-disabled learners. As reported above, the objective of this preliminary research was to bring out comparative results between both groups (Mills et al., 2006).

3.6 MOOC accessibility audit

Study C was developed to understand how to improve the accessibility in MOOCs for disabled learners (**RQ3**) from an expert evaluation perspective. The study employed an accessibility audit. The design of the audit is detailed in **Section 7.3**. In summary:

- The audit was conducted on 4 MOOCs, FL, Coursera, edX and Canvas, to help understand the current state of accessibility in MOOCs (**RQ3a**) (**Section 8.3)**.

- The audit has been validated by experts following inter-rater reliability evaluations with the objective of it becoming a useful tool to identify and address accessibility barriers (**RQ3b**) (**Section 8.4)**.

Previous research identified five components that distinguish the development of online accessible courses (Iniesto & Rodrigo, 2013):

1. **The authoring tool.** It is used to produce the educational resources, which can be part of the LMS either as a Web tool or a client application that runs locally in the operating system.

2. **The educational resources**. The educational resources embedded in the course (e.g. video or text-based files).

3. **The Web content.** It includes the user agent (i.e. Web browser) in which the educational content will be displayed; it is the client provided by the LMS for the learners to interact with.

4. **Metadata.** Added to a course and its educational resources by which they can be located in a repository.

5. **The course packaging**. Necessary for the exchange of courses between LMS'.

For component 1, authoring tools are offered by some platform providers to course providers to allow them to create, edit and upload educational resources. A specific case is Open edX Studio[38] software analysed by Sanchez-Gordon & Luján-Mora (2016c) while Canvas VLE[39] was considered by Sanderson et al. (2016). However not all MOOC platforms offer authoring tools. For this reason, this component is not included in the accessibility audit presented in this thesis. The objective is to identify different MOOC environments as viewed by the learner and to evaluate MOOCs as they are available online to understand the current accessibility state (**RQ3a**). This aspect is included as future research in **section 9.6**.

In contrast to other LMSs (Kalou et al., 2015), components 4 and 5 are not often implemented in MOOC platforms reflecting a lack of policies to promote the reuse of educational resources (Papathoma et al., 2016). The accessibility audit, therefore, focuses on components 2 and 3: the MOOC platforms (LMS) and the educational resources housed in MOOCs. For the audit design, research into the accessibility standards related to education has been considered. When referring to education-related standards, it does not mean these standards were specifically designed with an educational objective; rather they are the standards that could be applied to educational resources. The detailed review of standards can be conducted in **Appendix 10**.

The methodology in the audit combines accessibility evaluation methods (AEMs) across four main evaluation areas to compose four different checklists in a common heuristic evaluation approach (**Figure 3.3**):

- **Technical accessibility evaluation.** Checking of conformance to guidelines or standards through WCAG and the text-based files (Petrie & Bevan, 2009).

- **User experience (UX) evaluation.** The evaluation of usability and user experience characteristics of the user interface design and pedagogical design (Xiao et al., 2015).

- **Quality evaluation**. Evaluation of MOOCs properties, the quality of the design, platform and support for learners (Kear et al., 2016).

[38] edX Studio, https://studio.edx.org/
[39] Canvas VLE, https://www.canvasvle.co.uk/

Learning design evaluation. Evaluation of the learning design characteristics within MOOCs (Meyer et al., 2014).

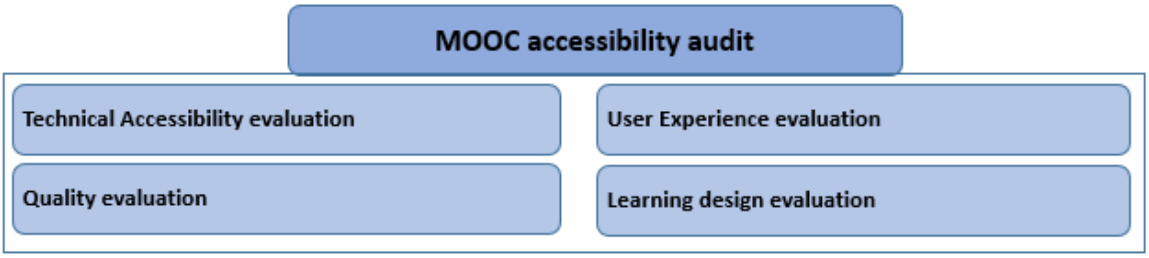

Figure 3. 3. The four components of the audit

To allow validation of the audit, inter-rater reliability was implemented. Inter-rater reliability, also known as inter-rater agreement, applies a score of how much consensus there is in the ratings given by various raters as a way to test validity (Hallgren, 2012). Inter-rater reliability is useful in processes to determine if a scale is appropriate for measuring a variable, and so is applicable to the case of the audit for each of the different checklists proposed. In the case of rater disagreement, it need not follow that the scale proposed is defective but that, for example, the raters need more training and better requirements (**Section 8.3**).

To help to understand the current state of accessibility in MOOCs (**RQ3a**) the accessibility information platform providers include in their websites, to inform both learners and course providers, needs to be evaluated. For that purpose, a typology of information quality of the public domain accessibility information in the main platform providers (selected in **Section 2.5**) websites has been included to complement the audit implementation (Stvilia et al., 2007). This is explained in more detail in **Section 7.3.1.** The general methodological aspects of each of the components of the audit are given in the subsections below. The experience of the researcher visiting IDRC and collaborating within the OLA! Project has been influential for the development of the accessibility and UX evaluation components, as was the visit to CAST for the learning design evaluation component (**Section 1.2**).

3.6.1 Technical accessibility evaluation

WCAG-EM[40] methodology was designed for experts who want to follow a common approach for evaluating the conformance of websites to WCAG. The use of WCAG is the standardised and commonly used approach for accessibility evaluation of MOOCs (as shown in **Section 2.6**). WCAG-EM has been designed with a heuristic evaluation approach in mind and developed from previous methodologies such as Unified Web Evaluation Methodology (UWEM)[41]. Reflecting on its extensive use, WCAG was the selected standard for the accessibility evaluation of the audit with the addition of evaluation aspects of text-based files commonly used in MOOCs such as PDFs. In line with the purpose of the audit to answer **RQ3** it was decided to use all WCAG criteria to AAA conformance level (the most restrictive). The technical accessibility evaluation is

[40] WCAG-EM, https://www.w3.org/TR/WCAG-EM/
[41] UWEM, http://www.wabcluster.org/uwem1_2/

defined in **Section 7.3.2**; the validation is in **Section 8.3.2**; and the implementation is described in **Section 8.4.3**.

3.6.2 User experience evaluation

Nielsen (1994) identified several usability techniques which are referenced in **Table 3.2** based on Burgstahler & Cory (2015). This Table shows that when evaluating UX, the relationship of accessibility and usability needs to be considered.

Table 3. 2. **Different usability techniques**

Usability techniques	Description
Heuristic evaluation	Usability specialists judge whether each dialogue element follows established usability heuristics
Cognitive walkthroughs	Simulates a user's problems solving process at each step, checking if the simulated user's goals and memory content can be assumed to lead to the next correct action
Formal usability inspections	Combines heuristic evaluation and cognitive walkthroughs
Pluralistic walkthroughs	Meetings where users and developers step through the scenarios
Feature inspection	Expert accomplishes checks for long sequences that would not be natural for users and that require extensive knowledge
Consistency inspection	Designers representing multiple projects inspect an interface to see whether it does things in the same way as their designs
Standards inspection	An expert on some interface standard inspects the interface for compliance

At the time of including aspects of UX in the audit, it was important to consider the usability in user interface design. Nielsen & Molich (1990) developed 10 usability heuristics which could have been adopted within the context of MOOCs. Although heuristic evaluations have been extended and adapted to online educational environments (Benson et al., 2002; Jimenez et al., 2016), the main limitation is that these heuristics are very general. Considering that the generality of technical aspects is covered with the technical accessibility evaluation component, this component design was desired to switch into an approach that empowers learners interacting in MOOCs common situations. Therefore the framework around this part of the audit is user-centred designed and the approach selected for this component of the audit is formal usability inspections (**Table 3.2**).

Rieman, Franzke, & Redmiles (1995, p. 387) define cognitive walkthroughs as *"a technique for evaluating the design of a user interface, with special attention to how well the interface supports exploratory learning"*. Cognitive walkthroughs help to identify usability and accessibility issues in a website. Cognitive walkthroughs include two separate activities: the development of personas and scenarios (Holzinger, 2005).

For the personas development, engaging personas perspective has been chosen by incorporating goal-directed personas. Engaging personas include a realistic description of people to draw evaluators into the lives of the personas, and thus avoiding stereotypical stories that focus only on behaviours by looking at the whole person (Floyd, Cameron Jones, & Twidale, 2008; Nielsen, 2013). The personas are goal-directed since these personas have been developed around the use of MOOCs and designed to be used primarily in the context of MOOCs. Nielsen (2013, p. 13) defines goal-directed persona by *"its personal, practical, and company-oriented goals as well as by the relationship with the product to be designed, the emotions of the persona when using the product, and the goals of the persona in using the product"*. For the audit, the starting source was real profiles from the disabled learners interviewed in Study B which provided a valuable

source in accessibility and use of MOOCs. These profiles meet all the requirements to be used as personas as characteristics are known such as their background, their personal interests, their experience participating in MOOCs and the accessibility barriers they have encountered.

For the development of narrative scenarios, the experience in EU4ALL project (Boticario et al., 2012; McAndrew et al., 2012) illustrates how scenarios were used within the software testing for the project. Rodriguez-Ascaso & Boticario (2015) reviewed the scenarios derived from this project to be reused on MOOCs. OLA! Project used a scenario-based approach to enhance open learning through that set of scenarios (Coughlan et al., 2016). The scenarios used in the audit were developed from these to evaluate common situations of personas participating in a MOOC environment (e.g. interacting with videos, P2P assignments or tests).

The set of cognitive walkthroughs is complemented with UX walkthroughs oriented to the learning design. UX walkthroughs have been applied in inclusive design, such as in the Fluid project[42]. UX walkthrough is a synthesis of methods that enables the evaluator to make assessments both from the learner's point of view and of a design expert, in this case the approach is not goal-oriented but to check if the designed tasks on a weekly basis or in the whole MOOC are feasible to be achieved by the personas. The UX evaluation of the audit is detailed in **Section 7.3.3**, its validation in **Section 8.3.3** and implementation in **Section 8.4.4**.

3.6.3 Quality evaluation

The quality of the design and the production of educational resources for MOOCs is an issue of relevance (Conole, 2013). Mulder & Jansen (2015) conclude if MOOCs can be an instrument in open education: MOOCs cannot remove all barriers to learning but can contribute to ensuring quality education to all. In the same line of argumentation, Schuwer et al. (2015) point out the lack of quality MOOCs to offer formal pathways to recognised academic qualifications and the inequality of access that provides. Stracke et al. (2018) reflect on the need to provide MOOCs with better quality to address new target groups allowing them to be used in multicultural and multilingual environments. Accessibility should be intgral to the quality of MOOCs.

Ossiannilsson, Altinay, & Altinay (2015) in their review of quality models in online and open education reflect that there is a movement towards convergence in the processes of quality assurance in HE. Authors emphasise the difficulties around quality in MOOCs considering they are not part of the quality assurance of HE quality standards. The MOOC Quality Project[43] (Creelman et al., 2014) involved researchers who found out collectively that it is difficult to define what quality means for MOOCs since their nature is continually changing with new types and variants of courses appearing all the time. MOOQ quality[44] needs to consider learners, designers and developers to produce a quality framework (Stracke et al., 2017).

[42] Fluid Project handbook, https://wiki.fluidproject.org/display/fluid/Design+Handbook
[43] MOOC Quality project, https://moocquality.wordpress.com/
[44] MOOC Quality, http://mooc-quality.eu/

The Quality Code at the Quality Assurance Agency (QAA) (J Rosewell & Barefoot, 2013) influenced the development of the OpenupEd quality label (Jon Rosewell & Jansen, 2014) based on the E-xcellence[45] approach of using a benchmark for quality assessment in MOOCs (Williams et al., 2012). It has been used to evaluate the quality in FL (Jansen et al., 2017) and UNED Abierta (Rodrigo et al., 2014). There have been several projects about quality in MOOCs within OpenupEd: ECO eLearning project (Osuna-Acedo et al., 2017), Score2020[46] (SCORE2020, 2016) and BizMOOC[47] (BizMOOC, 2017). As it has been tested, the version of the checklists produced for these projects has been the one adapted for this component of the audit detailed in **Section 7.3.4**; validation of the audit is in **Section 8.3.4**; and implementation of the audit is included in **Section 8.4.5**

3.6.4 Learning design evaluation

There are several theories about learning design for all. Tomlinson (2005, p. 263) described differentiated instruction (DI) as *"a proactive method of teaching involving modifying curricula, teaching methods, resources, learning activities to address the different needs of learners, to maximise learning opportunities for every learner"*. DI requires educators to know their learners beforehand to provide the educational resource that best fits their needs. Universal design (UD): *"represents an ideal concerning the audience for a specific environment; no application will be fully usable by every user, UD is a proactive process rather than a reactive one, to anticipate the preferences of a diverse group of users"* (Burgstahler, 2015, p. 6). When contextualising UD in learning frameworks include: Universal Design for Learning (UDL), Universally designed teaching (UDT), Universal Design for Instruction (UDforI), Universal Instructional Design (UID) and Universal Design for Instruction (UDI) as shown in **Table 3.3** based on (Burgstahler, 2015) and Center for Universal Design[48] (CUD).

Table 3. 3. Different UD frameworks for the design of instruction

UD framework for the design of instruction	Description	Seminal reference
Universal design for Learning (UDL)	3 principles, 9 guidelines, 31 checkpoints originally for undergraduate level and expanded to postsecondary learning	(Meyer et al., 2014)
Universally designed teaching (UDT)	7 principles and 8 guidelines of UD, applied to a wide variety of environments at all levels of education	(Bowe, 2000)
Universal Design for Instruction (UDforI)	9 principles of UD relevant to postsecondary instruction	(McGuire et al., 2003)
Universal Instructional Design (UID)	8 guidelines for undergraduate expanded to postsecondary learning.	(Lightfoot & Gibson, 2005)
Universal Design for Instruction (UDI)	Set of principles and guidelines organised under specific aspects of instruction	(Burgstahler, 2009)

Taking into account the massiveness factor included in MOOCs and the subsequent difficulties to get personalised feedback, a universal design approach is preferred to evaluate the learning design. The approach selected for this audit component to evaluate the learning design has been UDL, due to its thorough development and widespread use (Gronseth et al., 2019). The framework proposed by UDL is

[45] E-xcellence, https://e-xcellencelabel.eadtu.eu/
[46] Score2020, http://score2020.eadtu.eu
[47] BizMOOC, http://bizmooc.eu/
[48] Center for Universal Design, https://projects.ncsu.edu/design/cud/

intended to produce educational content following the principles of UDL rather than being evaluated once those resources are provided (Hall et al., 2015). UDL-IRN[49] has the mission *"to support the design of future-ready learning environments that are equitable, beneficial, and meaningful for all learners"* and seeks to do this by the integration of UDL and iterative design-based thinking including evaluation processes. In Europe, the Universal Design for Learning in Higher Education project[50] (UDLL) has developed guidelines into a European perspective.

The UDL approach is *"to present the information in ways that fit learners' needs, rather than requiring learners to adapt to the information"* (Rose & Meyer, 2006, p. 19). This approach is relevant to understand learners who may like the curriculum to adjust to their needs (Porter, 2014). One of the objectives of UDL *"is not simply the mastery of content knowledge or new technologies, it is the mastery of the learning process, education should help turn novice learners into expert learners"* [51], which aligns itself with MOOCs pedagogy (**Section 2.4**). The learning design component is detailed in **Section 7.3.5**, its validation in **Section 8.3.5**, and the implementation in **Section 8.4.6**.

3.7 Research methods considered

For this research design, other methods have been considered. The possibility of using case studies Yin (2014) to study in depth several situations was explored. However case study research emphasises the importance of context to the case while in this research the stakeholders as shown in **Section 2.5** are very diverse to be included in cases (Mills, Harrison, Franklin, & Birks, 2017). The research design is driven by the research questions which implied following a pragmatic approach to understand different realities of different stakeholder-groups in the three studies introduced in **Section 3.3.**

For Study A, focus groups were considered instead of an interview approach, given that focus groups have been used in accessibility research (McAndrew et al., 2012). However, semi-structured interviews were selected as the method to be used to understand different realities considering the different MOOC providers' profiles, as detailed in **Section 4.3.1**. The limitation of interviews is the generalisation of the results (Bloor & Wood, 2006), but, as refected in the literature review (**Section 2.5**), this study is exploratory and first of its kind in the area of MOOC accessibility.

For Study B, several approaches were contemplated:

- The possibility to get access to online survey data from other MOOC providers apart from FL was investigated; two platform providers that were formally contacted who declined that possibility. Following the same approach, course providers (outside the FL network) and a European Project funded were contacted and the necessary level of collaboration could not be established. The researcher also carried out investigations about course providers different than the OU in FL and was unable to identify

[49] UDL-IRN, http://udl-irn.org/
[50] Universal Design for Learning in Higher Education – License to Learn, https://udlleurope.wordpress.com/
[51] UDL tips for fostering expert learners, http://castprofessionallearning.org/project/top-5-udl-tips-for-fostering-expert-learners/

further partners that included disability markers in their surveys. In FL, all learners' data, in surveys and MOOC participation, belong to the course provider. This legal requirement has enabled this project to use data from MOOCs that belong to the OU in FL. The limitation from these decisions is the lack of other MOOC contexts besides FL in the sample. However, this aspect was mitigated, as it will be shown in **Section 5.5,** because the learners who were invited to participate had experience with other platforms for the interviews.

- Activity data from FL was also considered. This data consists of interactions that learners have within a MOOC. This kind of data has been already used in research (Cooper, Ferguson, & Wolff, 2016; Morris, Hotchkiss, & Swinnerton, 2015). As will be explained in **Section 5.3**, it was not possible to link learners IDs to the chosen survey data and so this option was rejected. It is, however, noted that the interaction data could have helped to point out possible accessibility barriers (**RQ3a**).

- Producing specialised surveys for the research and including them in FL was considered. Producing surveys would have allowed to design them to answer the research questions more directly (Perryman & de los Arcos, 2016). The pre-course survey could have been adjusted to ask particular questions on motivations (**RQ2**) and accessibility barriers (**RQ3**). At the post-course survey stage, learners could have been asked to evaluate the accessibility of the platform and educational resources offered during the course (**RQ3**). The complexity to include personalised surveys and the absence of courses related to accessibility to match the quetsionnaire to the motivation of the learners meant this option was also dismissed.

For Study C several iterations were considered to refine the process, including the possibility of interviews and focus groups with experts as it is explained in **Section 7.3**. Other considerations in the research design included:

- The participation of end-users in the evaluation process using IET usability laboratories. These labs allow participant observation (McLeod, 2015) with the use of software such as Morae[52]. This participation was left out due to the need to bring learners on campus. It would have been useful to evaluate with end-users, and this decision was mitigated by creating personas from real learners interviewed in Study C for the audit UX component (**Section 3.6.2**).

- To use the literature review in MOOC accessibility and the barriers identified during the interviews with disabled learners to validate the results from the audit implementation. Instead, the findings from three studies were used in a complementary way to answer **RQ3** (**Sections 3.3 and 8.5**).

Some of these research methods considered are part of possible future research as detailed in **Section 9.6.**

[52] Morae, https://www.techsmith.com/morae.html

3.8 Ethical considerations

For planning the ethical aspects of this research, the following aspects were considered: the lack of commitment of MOOC learners, the anonymity of the online environment, and the difficulty in knowing the proportions of learners. Further, in research that involves disabled learners, the recruitment can take considerable time (Britten, 2014). There are also ethical considerations that are particularly significant when conducting research with disabled learners: for example, to make the research methods accessible to a range of needs and providing accessible text-based files and online resources. Esposito (2012) indicates the evolving principles of online research ethics, within which it is worth locating an ethical decision-making process focussed on online learning, and more specifically in open educational environments and MOOCs (Farrow, 2016). In this project, British Educational Research Association (BERA) ethical guidelines were followed (2011, 2018).

Ethical approval for research was granted by the OU Human Research Ethics Committee (HREC). The process of interviewing MOOC providers and collecting the data through existing online surveys of the OU was approved by HREC (reference: *"HREC-2016-2249-Iniesto"*). The researcher requested for approval of the *"Application to research and release data on The OU's open educational resources"* and the *"Data Protection Questionnaire for Students"*. The process of recruiting participants for interviews and the conduct of the interviews was approved via *"HREC-2017-2451-Iniesto"*. For the accessibility audit, several meetings were carried out with two FLAN academics to investigate the ethics of publishing research using MOOC providers' non anonymised data.

Participants of 18 or older were considered so that they could give informed consent. Participation was voluntary and they could withdraw from the study at any time before the analysis of the data. Participants in Study B were sent a £10 voucher gift card on completion of the interview. Anonymisation of the interview and survey data and particular ethical considerations in the data collection are described in **Sections 4.4, 5.5 and 6.3** for Studies A and B.

After the ethical approval was granted, the General Data Protection Regulation (GDPR)[53] came into force and, so, the data protection processes were doubled checked with OU guidelines for compliance. Only the primary researcher and his supervision team had access to the data sets. All data sets were password-protected and stored on the secure OU firewall-protected servers. Any physical documents (such as paper surveys or interview recordings) were stored in a locked desk drawer to which only the primary researcher had access via a physical key.

3.9 Research timeline

Most of the interviews for study A were undertaken during 2016 (January 2016 to April 2017). For Study B, the process of processing the survey data took place from August until November 2016; interviews with

[53] GDPR, https://eugdpr.org/

disabled learners took place from May until September 2017. The accessibility audit started in October 2017 and ended in May 2018 (**Figure 3.4**).

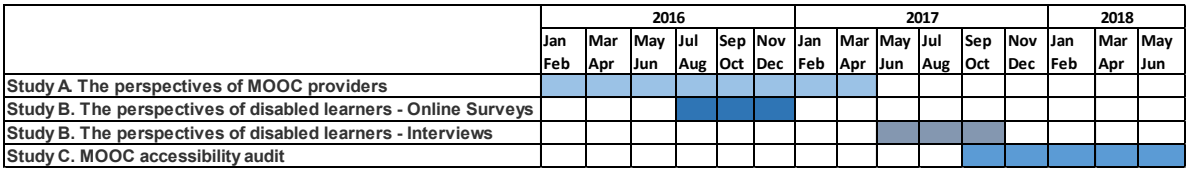

Figure 3. 4. Studies data collection timeline

3.10 Conclusions

This chapter has outlined the methodology of this research project by identifying research methods for each of the three studies and the ethical considerations of conducting research. The following chapters will describe the studies in depth including particular aspects of data collection and analysis, Chapter 4 describes study A; Chapters 5 (online surveys) and 6 (interviews) describe Study B; Study C is described in Chapters 7 (audit design) and 8 (validation and implementation).

4. Study A: The perspectives of MOOC providers

This chapter describes the study with MOOC providers. It is a qualitative study conducted to understand the perspectives of MOOC providers involved in the production of platforms and in the educational design of courses. The study also included the views from researchers in the MOOC community.

4.1 Introduction

As detailed in **Section 2.5**, MOOC providers include those who are involved in the development of MOOC platforms and the courses that are offered on the platforms. This chapter describes the MOOC providers' profiles and the interview design process (**Section 4.3**). The data collection and analysis including the transcription process and the iterations of thematic analysis and its validation are presented in **Sections 4.4 and 4.5**. The research findings and the reflections on the results for the research questions are described in **Sections 4.6** and **4.7**, respectively.

4.2 Research questions

In this study, the following research questions are addressed (**Section 2.7**):

- **RQ1**. How do MOOC providers cater for disabled learners?
- **RQ3**. How can MOOCs be made accessible for disabled learners?
    - **RQ3a**. What is the current state of accessibility of MOOCs?
    - **RQ3b**. How can accessibility barriers in MOOCs be identified and addressed?

4.3 Study design

This study aims to investigate the perspectives of MOOC providers towards disabled learners participating in their MOOCs and how they take into account their needs (**RQ1**), and to investigate the processes around the accessibility management in their organisation (**RQ3**). A set of interviews was designed to elicit the perspectives of MOOC providers.

The study design is aligned with pragmatism (**Section 3.1**). One of the limitations is that the profiles included in this study are professionals who work in areas of software development and educational content, as Libby & Rennekamp (2012) report it is natural to expect self-serving bias in how MOOC providers report the management of accessibility. For that reason, the overall research design includes further studies (B and C) with different points of view to answer **RQ3** (**Section 3.2**) and the incorporation of researchers in this study.

4.3.1 MOOC providers profiles

Figure 4.1 shows the division of different profiles related to accessibility for the MOOC providers as defined in **Section 2.5**: platform providers, those who provide the platforms to host the MOOCs and the course providers, those that offer the courses on the platforms. There can be cases where the platform and the course provider are from the same organisation, in-house (e.g. UNED Abierta) or different organisations

(e.g. edX) where it is common to have multiple course providers. These profiles also include an external group for the purpose of this study: MOOC researchers. This group complements this study with information from MOOC research projects with a different perspective than MOOC providers.

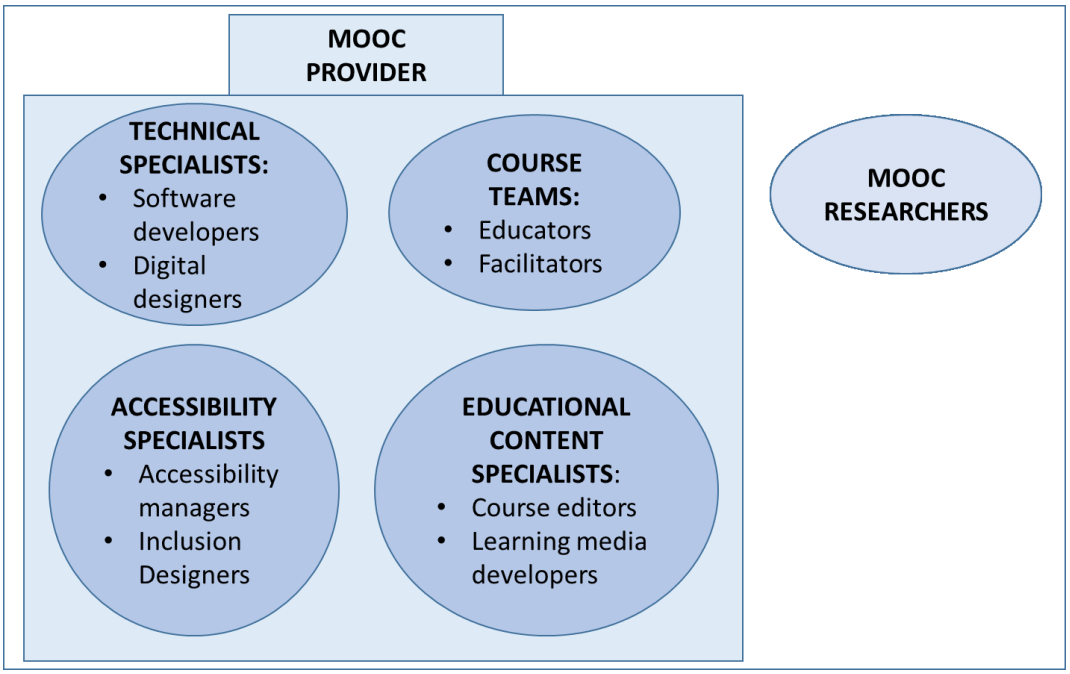

Figure 4. 1. MOOC providers and researchers

The definitions of the profiles are:

- **Technical Specialists.** This group includes those who work in the software development of the platform. For example, software developers who work in the programming aspects and digital designers who design the visual elements (Coates et al., 2005).

- **Accessibility Specialists**. Accessibility specialists may be involved in the platform development or can help to produce the educational materials in MOOCs, being responsible for the accessibility. This role includes accessibility managers and inclusion designers (Slater et al., 2015).

- **Course teams**. Course teams design the educational resources of the MOOCs. This group includes the educators and those who facilitate the discussion when the MOOC is being run (Hernández et al., 2016).

- **Educational content specialists.** Educational content specialists produce digital materials and support the course teams. This group includes course editors and learning media developers (Hernández et al., 2016).

- **MOOC researchers.** This group are not involved with the design and development of MOOC. Instead, they include researchers with interest in MOOC accessibility, quality in eLearning, learning analytics, open education, self-directed learning and UDL.

4.3.2 Design of interviews

An interview study with 26 participants was conducted to understand the perspectives of MOOC providers on accessibility. Different interviewees had different profiles, with the intention of capturing several perspectives to enrich the study (Bloor & Wood, 2006). This study has been designed in two phases, the first phase of 12 interviews was carried out and analysed to understand the quality of the data, consider initial results and identify gaps. The second phase of a further 14 interviews then sought to more comprehensively understand the MOOC providers' perspectives.

The interview protocols were trialled with three researchers to validate the prompting and order of the questions (Castillo-Montoya, 2016). The protocols were focused on three main topics corresponding to the research questions:

1 **Data availability and knowledge about disabled learners**. (**RQ1**). Around 10 minutes. The MOOC providers understanding of disabled learners taking part in MOOCs, how they handle this information and the way they work internally to take into account their accessibility needs.

2 **Daily work: MOOC providers dealing with accessibility**. (**RQ3a**). Around 15 minutes. The current state of accessibility and internal processes within the organisation regarding accessibility processes.

3 **MOOCs and adaptation**. (**RQ3b**). Around 10 minutes. The processes that involve addressing the accessibility barriers so that the educational resources and platform are adapted to learners.

In addition, some specific questions were designed for each participant based on their profile. For example, questions related to the educational resources to the course teams and questions related to software development to the technical specialists. The semi-structured nature of the interviews enabled the researcher to ask the interviewees to expand on their comments during the interview. Each interview was planned to last for 45 minutes. The project sheet, consent form and template for the interviews are included in **Appendices 1-3**.

4.4 Data collection

This section explains the participant recruitment and the sample obtained for the study.

4.4.1 Participant recruitment

For the selection of the participants, the list of main MOOC providers (**Section 2.5**) was considered alongside MOOC researchers from the literature review (**Section 2.8**) and previous research collaborations of the PhD research student (**Section 1.2**). From that experience, for the participant recruitment process, a list of 47 MOOC providers who could participate in this study was developed. Following Sapsford & Jupp (2006) a quota sampling approach was used, being a non-probability sampling method that divides the population into non-overlapping profiles. In this case, representatives were selected from the profiles defined in **Section 4.3.1** from a closed list (the 47 providers).

Participants were contacted by email. The response rate was high (26, 61.90%) from a total of 42 participants contacted. From those contacted 5 declined the invitation, 2 of those offering an alternative person within their organisation to be interviewed. 9 did not reply to the invitation; 2 agreed, though in the end the interview did not take place. Two different approaches were carried out to conduct the interviews:

- **Face to face.** In face-to-face situations at the start of each interview, participants were given a copy of the project summary sheet and verbal description and the researcher always introduced himself and his research. Face to face interviews took place in the working environment of the interviewee.

- **Online interviews.** Online interviews benefit from the time and geographical dispersion; one-on-one interviews were performed synchronously (real-time) encouraging interviewees who have time constraints to participate in the research (Janghorban et al., 2014). The use of the technology (Web camera) allows a comparable interaction as the onsite equivalent with the presence of nonverbal and social cues mitigating the fact of being in different places (Sullivan, 2012). Online participants were provided with the same information as face to face interviewees by emailing all the information before the interview is taken and again the researcher always introduced himself and his research, Online interviews were carried out using Skype[54]. All audio from the interviews was recorded using two devices: a laptop with Audacity[55] and a mobile phone with Cogi[56] software.

The recruitment process showed difficulties to include platform providers, which is reflected in the sample detailed in the next section. Where relevant, the interviewer allowed the interviewees to use Spanish, with the purpose of making them feel comfortable in their conversation and argumentation in their native language. Although this approach makes more difficult the analysis since extra effort in the transcription is needed (**Section 4.5.1**), it helps interviewees feel more confident and secure (Duffy et al., 2005). All the interviews took place between January 2016 and April 2017.

4.4.2 Sample

As shown in **Table 4.1** a fairly balanced coverage of the different profiles has been achieved with lower representation of technical specialists and educational content specialist.

Table 4. 1. MOOC providers' sample

Profile	Sample
MOOC Researchers	30.76% (8)
Course Team members	23.07% (6)
Accessibility Specialists	23.07% (6)
Technical Specialists	11.53 % (3)
Educational Content Specialists	11.53 % (3)

In **Table 4.2** "AS" stands for Accessibility Specialist, "CT" four Course Team, "ECS" for Educational Content Specialist, "MR" for MOOC Researcher and "TS" for Technical Specialist. The accessibility specialists include

[54] Skype, https://www.skype.com/en/
[55] Audacity, https://www.audacityteam.org/
[56] Cogi, https://cogi.com/

examples of 2 platform providers (FL and edX), 2 in-house MOOC providers (UNED Abierta and Telescopio) and 1 international project (ECO). The sample is represented by course team members from several MOOC topics, 3 of them are MOOCs that include teaching accessibility. The technical specialists comprise 2 in-house MOOC providers (UNED Abierta and iMOOC) and 1 platform provider (FL). The sample includes 3 MOOC researchers with expertise in accessibility, other topics covered are: learning analytics, open education, self-directed learning and UDL.

This study, as explained in **Section 4.3.2**, has been designed in two phases, the first phase included 12 interviews while the second 14. Each phase included 4 MOOC researchers, while phase 1 concentrates all the 3 technical specialists and phase 2 all the 6 course team members and the 3 educational content specialists.

Table 4. 2. Sample by the organisation, profile, platform provider, interview type and step

ID	Organisation	Profile	Platform provider	Interview	Step
AS1	FL	Accessibility Manager	FL	Face to face	1
AS2	Galileo University	Accessibility Manager	Telescopio	Online	1
AS3	ECO	Accessibility Manager	Several	Online	1
AS4	UNED	Accessibility Manager	UNED Abierta	Online	1
AS5	edX	Accessibility Manager	edX	Online	1
AS6	IDRC OCADU	Inclusion designer	None	Face to face	2
CT1	Colorado Community College	Educator	Canvas	Online	2
CT2	SUNY Empire State College	Educator	Canvas	Online	2
CT3	UNED	Educator	UNED Abierta	Online	2
CT4	Open University	Educator	FL	Face to face	2
CT5	Open University	Educator	FL	Face to face	2
CT6	Open University	Educator	edX	Face to face	2
ECS1	Open University	Learning Media Developer	FL	Face to face	2
ECS2	Open University	Course editor	None	Face to face	2
ECS3	Freelance	Course editor	FL	Face to face	2
MR1	UNED	Accessibility Researcher	UNED Abierta	Face to face	1
MR2	UNED	Accessibility Researcher	Several	Face to face	1
MR3	Polytechnic University of Madrid	Quality Researcher	None	Online	1
MR4	National Polytechnic School	Accessibility Researcher	None	Online	1
MR5	Open University	Self-directed learning Researcher	FL	Online	2
MR6	University of Leeds	Learning analytics Researcher	FL	Online	2
MR7	Fontys University of Applied Sciences	Open Education Researcher	None	Online	2
MR8	CAST	UDL Researcher	None	Face to face	2
TS1	FL	Software developer	FL	Face to face	1
TS2	Portuguese Open University	Software developer	iMOOC	Online	1
TS3	UNED	Software developer	UNED Abierta	Online	1

The distribution of the interviewees' organisations has a dominant presence of OU (6) and UNED (5), reflecting the affiliation of the researcher and the significance of both institutions in MOOC research.

Another distance university is represented, the Portuguese OU (Universidade Aberta) which hosts its in-house MOOC platform iMOOC. A total of other 7 universities and 2 research centres are represented. Regarding the affiliation to platform providers (either for professional, academic or research purposes), FL leads the list with 8, while 6 of the interviewees have no affiliation and 4 are linked to UNED Abierta. The languages used to participate in the interview were English as a native language for half of the sample (13), 9 were taken in Spanish and 4 in ESL, therefore 17 of the interviews were conducted in English. Most of the interviews were carried out online (14).

There are missing voices in this sample, including profiles as facilitators, MOOC researchers in areas like professional development and platform providers. Other voices are overrepresented such as having more course team members over technical specialists. The limitations of this research are considered further in **Section 9.5**.

4.5 Data analysis

This section sets out how the transcripts have been produced and analysed using thematic analysis.

4.5.1 Transcription process

Complete transcripts from the verbal data have been produced from the recorded audios, all of them created by the researcher in an exercise to understand and familiarise with the content of the data (Lapadat & Lindsay, 1999).

Challenges associated with foreign language transcription are common in this process (MacLean et al., 2004), the researcher, whose mother tongue is Spanish from Spain, had to face differences with Latin American Spanish, ESL and American English. The terminology has been kept consistent, for example, preferring the use of learners over students, people or users; or subtitles over captions.

For the quotes selected and presented in the research findings **section 4.6** an intelligent verbatim transcription approach has been used; this means the researcher has performed light editing to correct sentences, grammar and irrelevant words. Following MacLean, Meyer, & Estable (2004) an edited transcription to use British English and identity-first language was adopted to homogenise the quotes and to support the social model.

4.5.2 Analysis process

As indicated in the methodology (**Section 3.4**), the 6-phase methodology of thematic analysis by Braun & Clarke (2006) has been applied three times as shown in **Table 4.3**. The process had two levels of depth, using themes and sub-themes. The themes and sub-themes represent an interpretative level approach (i.e. not

requiring literal words to appear in the transcripts) (Boyatzis, 1998). For the analysis, the researcher has combined manual techniques using printed copies and computer-assisted software such as NVIVO[57].

Table 4. 3. Thematic analysis in study A

Phase		Iterations
1.	Familiarising with the data	2
2.	Generating initial codes	3
3.	Searching for themes	3
4.	Reviewing themes	3
5.	Defining and naming themes	3
6.	Producing the report	1

The three iterations detailed are:

- **The first iteration.** This iteration included 12 interviews from phase 1 as shown in the study design (**Section 4.3**). An inductive approach of qualitative data analysis approach was used. This allowed a better understanding of MOOC providers' opinions and helped to identify missing data required to answer the research questions (Tuckett, 2005). The analysis generated 5 themes and 17 sub-themes.

- **The second iteration.** This interaction included 14 more interviews from phase 2, including missing profiles in the previous iteration. The same inductive approach was used to develop a total of 6 themes with 32 sub-themes. This iteration allowed a profound understanding of the data set, considering the diversity of profiles interviewed. However, the number of themes and sub-themes that were produced from this iteration was too broad and the inductive proposed themes did not in all cases help to answer the research questions.

- **The final iteration.** This iteration was carried out with a deductive nature. The final iteration had the objective to answer the research questions proposed for this study and themes that did not help to answer them were removed. The MOOC structure proposed in the literature review (**Section 2.5**) was used to update the sub-themes of the theme *"MOOC educational enablers"*. An effort to merge the themes and sub-themes and refine their semantics was taken, resulting in 4 themes and 13 sub-themes.

The thematic map from the first two iterations can be seen in **Appendix 4**.

4.5.3 Analysis validation

To validate the semantics of the final iteration an inter-reliability process has been followed with one the supervisors; providing 105 quotes (18.48% of the data set) and 3 possible answers between randomised sub-themes, the agreement was substantial with a Cohen's Kappa of 0.71 (**Table 4.4**).

Table 4. 4. Cohens Kappa for the final iteration validation

	Value
Relative observed agreement	85/105
Hypothetical probability	1/3
Cohens Kappa	0.71

[57] NVIVO http://www.qsrinternational.com/nvivo/nvivo-products

4.6 Research findings

In this section, the thematic map of the final interaction is introduced (**Figure 4.2**). Its themes and sub-themes are defined; representative quotes are broken down, to show the most significant findings from the interviews.

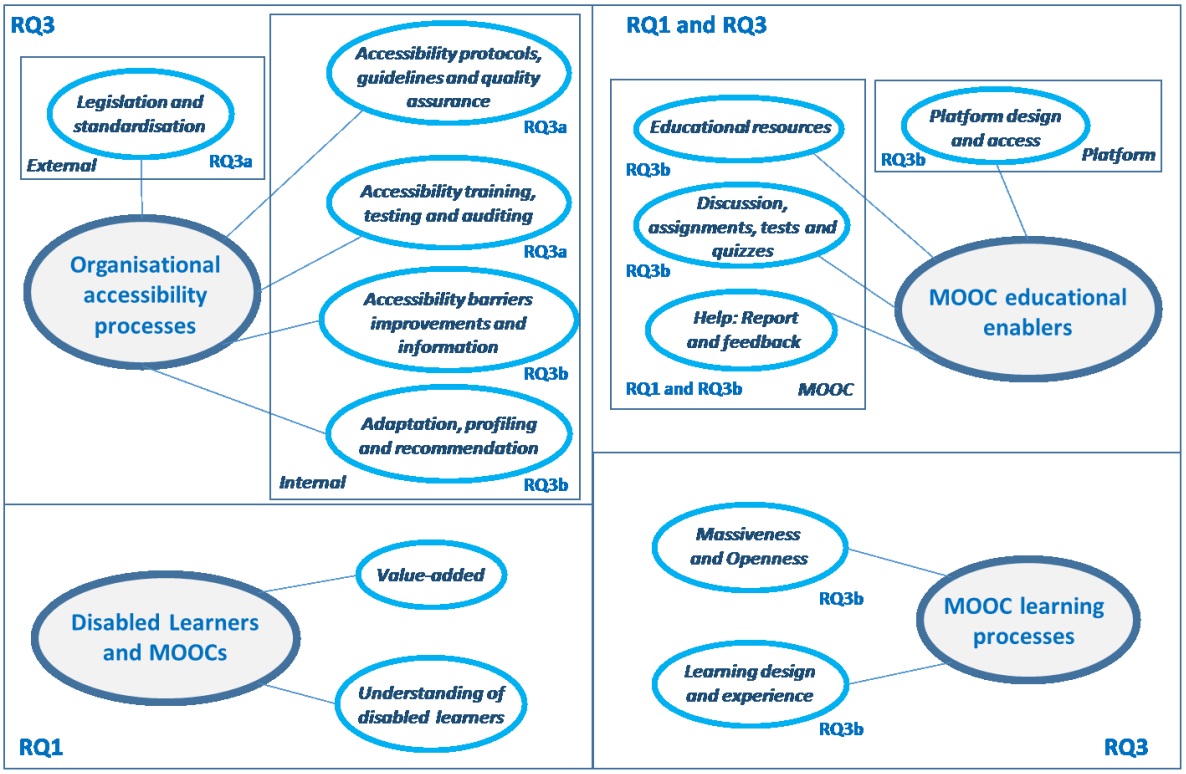

Figure 4. 2 Thematic map representing the themes and sub-themes at the final iteration

The analysis process followed led to a close relationship between sub-themes, for example, while discussing the sub-theme *"Value-added" ("Disabled learners and MOOCs"*) can address aspects of learning processes like *"Openness and Massiveness"* ("*MOOC learning processes"*). While talking about internal protocols (*"Accessibility protocols, guidelines and quality assurance"*, *"Organisational accessibility processes"*) can be linked with *"Educational resources"* (*"MOOC educational enablers"*).

Quotes used in this section are attributed following this structure:

(ID, Organisation, Platform provider)

4.6.1 Disabled learners and MOOCs

Disabled learners and MOOCs (RQ1). The relationship of disabled Learners with MOOCs from the MOOC providers' point of view.

- **Value-added (RQ1).** The value-added of MOOCs to disabled learners from the MOOCs providers' perspective.

Some providers and researchers reported disabled learners' motivations do not necessarily differ from those of non-disabled. Learners are taking MOOCs as a way to improve their career and study opportunities, acquire skills to get a job, get a certificate, and benefit their lifelong learning, adding the factor that content is for free or limited cost. Other participants interviewed reflected MOOCs can make a difference for disabled learners considering the options to work in their place and pace and the benefits technology offers.

> *I think that **MOOCs are attractive to disabled learners because they break down a lot of the barriers**. (…) They may also face discrimination because any disability that they may have is invisible, they interest or in the digital world because of the availability of assistive technologies, the digital world is potentially more accessible, for all those reasons **MOOCs are more attractive to disabled learners**.* (Accessibility Specialist 5, edX, edX)

- **Understanding of disabled learners.** How MOOC providers understand the participation of disabled learners in MOOCs. **(RQ1).**

From the platform providers' perspective reported, there is a lack of knowledge of the number of disabled learners taking part in the MOOCs hosted in their platforms (and of participants in general). The only available data are the support requests where learners self-identify as disabled. MOOC providers ask minimal information of their learners when they register, and they do not track the use of assistive technologies.

A similar situation is pointed out by course providers, the standard way to get to know the necessary information is using surveys, and they usually get a limited amount of data analytics and that is not related to disabilities. A further resource mentioned for course providers are the comments provided within the MOOC and related to the educational content, which is not necessarily linked to disability.

> *If we miss the transcripts out by accident, because of the time pressure and things like that, there are moments where **the course goes live on Monday, and the transcripts are not ready** yet until Tuesday morning. **You will have learners commenting where is the transcript**.* (Educational Content Specialist 1, Open University, FL)

There are cases where awareness of accessibility barriers is shown to learners. It is important to notice the fact some providers assumed accessibility affects specific disabilities.

> ***We warned that there might be issues with accessibility is for disabled learners**, (the course) requires lots of typing. (…) I think some people just see the introduction video, click the button to register, and they don't read the rest, so it is there if they are aware, I'm not sure. (…) **Blind learners won't be able to take this course because, it's like in any programming environment** (…) the screen reader probably can read it, but as you write it I don't think it would be read aloud so, **we assume blind learners are not taking this course.*** (Course Team 5, Open University, FL)

MOOC providers were aware the use of Web technologies can add accessibility barriers, for example, the excessive use of videos and their length affects the learners' attention span. In that sense developing better designs including the personalisation of the experience can help.

> *I think the more MOOC designers pay attention to disabled learners the better their designs are going to get to be for everyone, **for disabled learners personalisation of their experience is vital because they are in the margins of the population**. What it will show MOOC designers is what the advantages*

*of paying attention to individual variability to **make their designs more accessible to the learner but mostly more effective**.* (MOOC researcher 8, CAST, None)

As indicated by MOOC providers, disability is a broad term that includes many different situations, and accessibility may require multiple adjustments for diverse learners. Massiveness and openness are helpful for inclusiveness since MOOCs give particular value to the social interaction and that is something learners can be looking for so as to not feel isolated while learning online.

*We have seen anecdotal evidence of **learners saying they like taking the courses because it exposes them to other learners** or it has the social and the community elements, **getting to talk to people when actually they might be more isolated at home**. Maybe because they're disabled, or because they have to take care of someone else who is disabled, and so you simply give some opportunity to interact with other learners in other places.* (Accessibility Specialist 1, FL, FL)

4.6.2 Organisational accessibility processes

Organisational accessibility processes (RQ3). Accessibility internal processes in MOOC production.

- **Legislation and standardisation (RQ3a)**. International and national accessibility legislation and standards linked to MOOC production.

Discussion with providers and researchers showed one factor for accessibility is the legislation and the standards applied to technology; national and international bodies providing guidelines to enhance accessibility. There are a variety of standards, and lack of unification may create difficulties in the organisations to capture all the information and be sure they are achieving the correct level of accessibility. A need for a harmonisation process that joins all the accessibility efforts around the world was claimed, although there is a general perspective that WCAG is the de facto standard and that all national legislation try to adapt to it.

Some of the providers complained legislation is not necessarily being followed and that there are countries with strong legislation, but they are lax when applying it. In MOOC production there may be several countries' legislations involved; the platform has its own, but in an international environment like MOOCs, the educational resources produced for the courses can come from different countries with diverse legislation. It is crucial for MOOC providers to understand where the responsibilities lie and how to deal with reported accessibility barriers.

*We have an international audience using our courses including **the course content and each of them is subject to their own laws and legislation**. We tell them that this is our recommendation. **We follow WCAG double-A, and we encourage them to do so as well, but ultimately the responsibility lies with them**, and if it is reported to us that course content is inaccessible or that disabled learners are having a difficult time using their course content, **the support request goes directly to the course team responsible for maintaining that course**.* (Accessibility Specialist 5, edX, edX)

Another aspect discussed was that more restrictive legislation in some countries may be enhancing accessibility, since platforms like Open edX or Canvas VLE are available to be used worldwide, with Open edX being an open source software (OSS) initiative. Software-based in the US has to comply with a strong accessibility regulation. Open edX is engaged with open development communities, so if that software is

being reused in other countries with lax accessibility legislation, an accessible platform may be provided even it is not required.

> *Countries with strong legislation and determined to fulfil it as the US, combined with the fact that current MOOC platforms are open development communities, that means* ***that if Open edX is more accessible, these improvements will be implemented in other organisations that use it****, even if these organisations are in countries that do not follow the legislation.* (MOOC Researcher 1, UNED, UNED Abierta)

- **Accessibility protocols, guidelines and quality assurance**. Internal protocols followed in accessibility, and guidelines developed to keep the quality assurance in MOOCs. **(RQ3a).**

Considering accessibility is a critical aspect in software development, platform providers pointed out they have their internal accessibility protocols and guidelines, which are diverse and are developed following different circumstances. For example, as acknowledged by FL participants, it has its accessibility guidelines, and that guidance about content accessibility is available on the partners' website for all course providers.

Accessibility protocols need to be considered in course production, which means quality assurance during the product development is needed that is not only focusing on the educational resources but also in the assignments, discussions and quizzes. For example, edX has an accessibility and UX team working closely to improve the tools they provide to course teams.

> *We're going through those exercises now or under* ***redoing our discussion forums as well as our assessment process*** *which is something that every course uses and often gets very challenging to use as the assessments get larger and more complicated. There are* ***lots of different feedback mechanisms****, the question can have multiple chances to get it correct or incorrect, and it's a very highly interactive experience where we're working on optimising it,* ***it takes a lot of careful thought and consideration and a knowledge in accessibility and UX*** (Accessibility Specialist 5, edX, edX)

Platform providers, therefore, showed they have different approaches to raise awareness of accessibility to their course providers, mostly through guidelines though can include training. Some platform providers indicated responsibility lies with the course team (the course provider). Policies vary from MOOC providers, edX, for example, do not require any level of accessibility on the course teams' part with the exception that they require subtitles and will not permit courses to go online with that feature missing. FL provides training to its partners.

> *The partnership managers work very closely with a partner to get their first course off the ground we give them a* ***workshop start to give them an overall idea of what to expect****. But after that it's the case of sending them a lot of* ***detailed information on the partners' site that would include the accessibility guidelines*** *(…). Which is basically* ***the kind of information that a partner will look at in order to create the course*** *so it is part of the main things they should be thinking about.* (Accessibility Specialist 1, FL, FL)

The perspective shown by MOOC providers is that they tend to provide guidelines to course providers, in the case of edX this includes through its authoring tool (Open edX Studio). While there is a common position that accessibility responsibility lies with course teams, there are differences between processes required of course providers to develop the educational resources. For example, in the case of FL when it comes to

subtitles and transcripts, there is a whole process which means that the partner must send the videos to a transcription service or transcribe them themselves. Course providers then send back a file which works with the subtitles; subtitles once uploaded are automatically turned into a transcript which then it is built into the page. UNED Abierta provides templates in both Word and PowerPoint once the educational resources are delivered, they check if they comply with the regulations, though in their guidance subtitles are not compulsory.

Course providers recognised that they have a responsibility for care of accessibility, and they have their guidelines. Approach for some of them depend on how they are embedded within their organisation. In some cases, the course team deals directly with accessibility while in other organisations, different roles are defined, and course teams are not familiar with accessibility. This process appears easier in in-house MOOC providers such as UNED Abierta where guidelines are common for the MOOC production process.

> *It's a policy of Colorado Community College System that* ***anything offered for our students has to be accessible to either WCAG 2.0*** *(…)* ***and 508 compliance*** *(…)* ***We have one college that's chosen to have a department that does that****, we have several colleges who are training their faculty that anything they touch has to be accessible.* (Course Team 1, Colorado Community College System, Canvas)

There can be mismatches between the platform and course providers' policies, some course providers claim their accessibility guidelines are better than the platform where they host their MOOCs.

> ***We would generally follow our own accessibility guidelines because they are higher than FutureLearn's****, these are making sure that there is always accessible text behind each image, making sure there are transcripts (…).* ***We were working around because the system didn't let us be as accessible as we wanted to be****.* (Educational Course Specialist 1, Open University, FL)

Accessibility policies in course providers can be different from one organisation to another; there may be more or less experience and understanding of accessibility. The reported experience of course providers suggested that they first need to develop accessibility awareness and the course provider offering the MOOC has to be aware of disabled learners' needs. Course providers mature from the technical point of view and also as an organisation to address those needs, recognising there are several actors who are part of accessibility.

> *For most universities this is almost the first time they see accessibility guidelines (…) they're not coming from a background of writing pedagogically design courses with accessibility on mind.* ***For a lot of universities that don't make an online offering this is the first time that they come up against it,*** *so there's a number of factors where then* ***maybe don't actually have an in-house policy****.* (Educational Course Specialist 2, Open University, None)

Platform providers encourage course providers to develop processes to improve accessibility and provide different experiences by producing educational resources in different formats. There is a general assumption by platform providers that course providers do not do as much as they could to write good audio-descriptions for videos or comprehensive descriptions (e.g. describing diagrams or graphs). When course providers are up against a deadline it is challenging to get them to prioritise accessibility because it is time-consuming.

> *It becomes very difficult to convince course teams to offer an alternative experience. When you tell a course team, well* ***video might not be the preferred way of learning for a learner, you may want to consider offering it a text or some other alternative experience****. It comes to a hard issue because they say:* ***we have spent so much time or money creating this video****, the same occurs with an interactive assessment process that may not be available to learners with a particular disability.* (Accessibility Specialist 4, UNED, UNED ABIERTA)

Course providers may not know enough about accessibility while producing the educational resources, especially as in the MOOC production there may be course teams from different countries and contexts where accessibility is not a priority, which is related to the legislation.

> *The universities we were working with, the****y were not aware that accessibility could be useful for them****, unlike other countries such as the UK or US or Spain no legislation tells you to have accessible content. (…), we have different realities in Latin America and Europe,* ***the most interesting is that the course teams were interested in why we need to have accessible content****.* (Accessibility Specialist 2, Galileo University, Telescopio)

- **Accessibility training, testing and auditing (RQ3a).** Training and testing in accessibility and audits to platforms and courses.

As reported by the providers, quality assurance processes include accessibility testing from both platforms and courses. edX provides automated tools to course providers to help that process, while other course providers need to develop their testing. Some platform providers recommend course providers hire accessibility experts. Platform providers acknowledged having protocols to test the platform accessibility during the development and maintenance cycles.

> *We did have when the product was being developed initially,* ***we did our own testing using screen readers and other standard tools to make sure that it was accessible****. Then we launched, we did our public launch* ***we got a lot of feedback from disabled learners*** *around various aspects, we did some improvements thanks to that feedback since then because* ***we are kind of making iterative changes to the platform****.* (Technical Specialist 1, FL, FL)

In general, course providers agreed authoring tools can help to create accessible educational resources. Course teams who have limited knowledge about accessibility can be helped and trained through use of those tools. There was an understanding from course providers of the need to include accessibility at the beginning of the design stages, as adapting produced educational resources is time-consuming.

> *Accessibility has to be incorporated from the beginning,* ***when you do not know anything about accessibility you can think that it is just added work****, work that you have to make an extra effort. Now that I have finished the video I have to make it accessible, and that is a mistake, because you have to consider the accessibility before, but is a slab because the video cannot be modified.* ***If you incorporate accessibility from the beginning, we all win, because the video gains a lot of quality****.* (Course Team 3, UNED, UNED Abierta)

Training is a process to increase awareness of accessibility, as commented, some platform providers train their course providers, while training in other cases depends on the course providers themselves.

> *What we did was a* ***massive training for course teams on how to create accessible content****, from the most basic to create an accessible Word, how to make accessible power point presentations, like the accessibility of a PDF, what a video has to have to be accessible. With* ***small techniques can be***

> ***done from your own computer without the presence of a specialised technician*** *who reviews the accessibility.* (Accessibility Specialist 2, Galileo University, Telescopio)

- **Accessibility barriers: improvements and information (RQ3b)**. Proposals to improve the accessibility barriers and provide accurate accessibility information to learners.

One of the ways MOOCs providers have to identify accessibility barriers, as has been mentioned, is thanks to the learners reporting them. The learner should be supported to report accessibility issues, and in such a way MOOC provider could work to improve those barriers.

> *We always have a first unit explaining the operation of the course and platform; you could know at that module what an accessible MOOC is. Also,* ***I would encourage to motivate learners could inform anything they see that is not accessible****, and that can be improved.* (Accessibility Specialist 5, ECO, Several)

Platform providers indicated one of the approaches to show accessibility awareness is to encourage course providers to report if there are known limitations at the beginning of the course. When offering information about accessibility to learners, MOOC providers agree showing some information related to accessibility at the beginning of the MOOC can be helpful. This information could appear before signing up for the course or at the very beginning in the course description page. This information has to be shown as advice, not as a limitation to take part in the course.

> *One of the things they said was that they wished that the courses would have* ***some indication of the difficulty of the language that was used in the MOOC*** *so both in the written language as in the spoken language. Because that way* ***they could assess before starting a MOOC which English proficiency was needed*** *and because MOOCs are targeting a global audience I think that would also help in with the filtering process that learners in the broad sense need to have.* (Course Team 4, Open University, FL)

Other providers suggested the learner should know if an accessibility audit had been conducted on the course. Some providers believed this information could be added with some iconography or visible certification.

> *We think that by making that explicit on a course page, it might actually help the partners as well on when putting that list together having to declare on that page* ***how accessible it is it might really bring into focus the importance of accessibility*** *and remind them to think about* ***it is a way that impacts their course****.* (Accessibility Specialist 1, FL, FL)

- **Adaptation, profiling and recommendation (RQ3b).** The adaptation of the content following learners' needs. The recommendations related to accessibility made public to the learners.

In general, providers and researchers pointed out that profiling of learners is critical so that learners can filter their content based on their needs to reduce the amount of searching and the disappointment that might be associated with online learning. Profiles should be easily modified and adapted to learners' needs.

> *Where MOOCs could be powerful is to realise having a profile is the first step but in fact what MOOCs can do by paying attention to what's going on now is to track the changes in your profile, immediate changes.* ***Right now you're tired and the pathway that would have been going for you at nine in the morning isn't the same path after lunch and the fact that your mother died last week changes***

> ***the kinds of trajectories that are going to be comfortable for you now and optimal for you*** *now. I think the power of MOOCs is in continuous monitoring and changing and updating what your profile is.* (MOOC researcher 8, CAST, None)

Personalisation may allow recommending MOOCs to the learner once preferences are known.

> *From the beginning,* ***learners could decide their preferences for how they wish to receive the content****, so that when you start the course, the choices you have decided to appear, always giving the option to return to another alternative content****. Learners could define their preferences globally, and at the beginning of each course, you can leave a message text that tells this course meets all the preferences you have chosen****, or you mark with an X those that meet the preferences and shows you the possible alternatives you have if the original preferences are not being followed.* (Accessibility Specialist 2, Galileo University, Telescopio)

4.6.3 MOOC learning processes

MOOC learning processes (RQ3). All the processes that include pedagogical and educational approaches which affect the accessibility.

- **Openness and Massiveness (RQ3b).** The effects of open access and massiveness in MOOCs accessibility.

The benefits of openness were discussed with MOOC providers and researchers. Some providers reported that the MOOC philosophy comes from open education, which is based on offering open training and open educational resources and is a philosophy of low cost to the learner. Learners only need to pay when they need a certificate. Openness for some MOOC providers was understood over a wide range that includes open source software and reusability of the educational resources. Openness is seen as a vehicle for accessibility, as the fact learners do not have to pay for the courses increases their accessibility.

> *If you are fully engaged in that kind of rhetoric* ***fully open, you are developing content in a way that is more easily accessible genuinely****. Therefore, if you engage MOOCs on that level, yes, they can help to encourage accessibility. If you take a more cynical view and you're looking at them as a promotional thing, saying that is open but is not really open, and I think it probably can impede access quite significantly (…)* ***if we are engaged in the open agenda, it supports accessibility****.* (Course Team 6, Open University, edX)

Massiveness is another aspect in MOOCs, MOOC providers acknowledged the fact that learners cannot get individualised feedback. Scale of operation also implies that reporting accessibility barriers does not mean they are going to be solved immediately, creating frustration.

- **Learning design and experience (RQ3b).** The MOOC learning design and its pedagogies. The experience including aspects such as engagement, motivation, digital literacy, cultural diversity, language and self-directed learning aspects.

MOOC providers indicated that learning and pedagogical design matters, and course providers agreed the quantity of material delivered each week can be excessive or have lots of tiny educational bits to pad out the week syllabus. Some course providers contemplate the option to offer different learning itineraries, providing different profiles for learning engagement and types of certification.

> *In some courses we have tried this, offering different itineraries, as well as* ***our courses, are not linear,*** *but one that is "step by step",* ***we try that the courses can be studied in terms of each one's needs*** *than one online learning, you can pass to unit four without studying unit one, this is one of the keys. There are other courses that have three different kinds of profiles depending on the level of learner engagement in the course, that* ***the focus is not only if the learner wants to obtain a certificate****. For example, if the learner just wants to have a look around also can get a certificate, a different one, so that they are not obliged to have to do all the assignments and all content* (Accessibility Specialist 3, ECO, Several)

Course teams pointed out they try to create compelling and interactive learning experiences, and it is relevant to consider accessibility when designing those experiences. For example, language can be an accessibility barrier that can influence the experience and can also add difficulties to platform providers since they have to provide customer support in those languages including the need to have facilitators who can read the comments and interact with learners.

> *We knew that the topic would be of interest to global learners, so we're definitely trying to think about* ***how to make accessible in terms of, smart cities can vary a lot in terms of different cultures and countries around the world take very different approaches****. What we tried to do was to use case studies from around different parts of the world (…), I was trying to make the language simple, avoiding kind of terminology that learners would not understand. (..)* ***Some learners find videos quite hard because you have to speak quite slowly, you are still speaking too fast for learners that English isn't their first language and so they then find the transcripts really helpful****.* (Course Team 4, Open University, FL)

4.6.4 MOOC educational enablers

MOOC educational enablers (RQ1 and RQ3b). The MOOC educational materials and external resources that enable accessible learning through MOOCs.

- **Platform design and access (RQ3b).** The design of the platform and access to it.

MOOC providers reported it is essential to consider the platform design. Learners need to know how to use the platform helped by signposting and the design should be as simple as possible. Platform design should be flexible to allow MOOC providers to develop different learning paths in MOOCs.

> *Generally,* ***would simplify the interface****, because there are usually many buttons, many tabs. For a disabled learner, it is very difficult to know where she is.* ***I would simplify it*** *with just a next button, a simple menu on one side and that way the page is very simple.* (Technical Specialist 3, UNED, UNED Abierta)

Inadequate access to the platform and the MOOCs educational resources can be related to the lack of internet connection. Learners should be able to download content (e.g. videos, transcripts or text-based files) and for it to be converted to a different format or printed.

> *Something that we don't do very well. It's somewhat like the offline content. You know because to be able to download the videos for example to your phone and watch them. We have queries from learners who want to do courses in remote parts of the world where you have people that have problems to get an internet connection.* (Technical Specialist 1, FL, FL)

- **Educational resources (RQ3b).** All the educational resources included.

Some of the suggestions indicated that the educational resources should include accurate subtitles and transcripts and that their format, use of terminology and cultural barriers (geographical or cultural references) need to be considered. Length of videos and clarity of the language used in then is relevant when using a blackboard during in the video; all the information should be audio described, leaving space in the screen for introducing subtitles and sign language in a different track.

> *Never have **anything longer than a minute, and if it's absolutely necessary for particular learning purposes it can go on for maybe two and a half minutes**, but only if it's launched in a very particular way beforehand and cradled afterwards. There have to be reasons for doing everything, every second of the material has to work for its living, to get value.* (Educational Content Specialist 3, Freelance, FL)

Other suggestions included that guidance to course teams needs to be provided to make the educational resources accessible (e.g. videos or text-based files); the platform providers can help course providers giving how-to-do guidelines and providing authoring tools to help to fix accessibility errors.

> *There should be provided g**uidance so that the course team knows how the materials have to be uploaded**. For example, the videos have subtitles, (…) but also how **to fix potential errors**, such as the PDFs, because they do not know how they have to fix them. Therefore they should be provided with **tools to validate the accessibility** of resources and correct them* (MOOC Researcher 3, Polytechnic University of Madrid, None)

- **Discussion, assignments, tests and quizzes (RQ3b).** Forums or discussions, assignments, tests and quizzes.

As reported, course teams tend to access the discussions as a source to find on accessibility barriers. Discussions need to be designed to find topics easily, not only for the learners but for the course team to help learners. The assignments, tests and quizzes can add accessibility issues and increase the dropout rate, some of the ideas proposed by course providers are to make P2P assignments optional or to lower the scoring percentage of these assignments to encourage learners to participate.

- **Help: Report and feedback (RQ1 and RQ3b).** Report and feedback on accessibility barriers.

When learners look for help to report any accessibility barrier, platform providers offer different alternatives as reported by the interviewees:

- **FL**. FL provides a question mark button on every single page and an email address on to the site contact page. They get massive amounts of feedback comments every day about lots of different things including accessibility. FL has dedicated customer support people reading all the feedback comments. When the course is being run the support team is still fixing things during the first weeks.

- **edX.** edX has a tracking system where accessibility barriers get treated like any other bug. edX has a category system: category one is reserved for a loss of functionality, if it is a barrier that affects everybody then it would need to be fixed right away (high priority bug).

- **Canvas.** Canvas provides a dialogue box with a help form that learners can fill out; then Canvas support will address it. They have a dedicated accessibility form “report accessibility issues here link”.

Therefore, platform providers follow different approaches to address reported accessibility barriers. Some course teams proposed to encourage learners to report errors to the platform providers and to help each other in the discussions.

> ***We encourage our learners to help each other*** *as well because often, the* ***learners can spot an issue quicker than a facilitator****, because they are reading through everything, they can see something.* ***They can come back to us if there is a problem*** *with the resources or help another learner where they don't understand something.* (Course Team 4, Open University, FL)

Providers and researchers acknowledged that to better understand the learners, platform providers need to facilitate options for help, and help buttons can be a good way to achieve that.

4.7 Discussion

In this discussion, the findings of the previous section are presented in the context of research questions of this study.

RQ1. How do MOOC providers cater for disabled learners?

To better understand how MOOC providers perceive the motivations for disabled learners are for participating in MOOCs, there are two perspectives which are identified with the theme and sub-themes: *“disabled learners and MOOCs”*; and sub-themes *“value-added”* and “u*nderstanding of learners”*. One perspective expresses that the motivations are the same for all learners. The other perspective presumes disabled learners are disfavoured in the society and MOOCs can broaden their CPD perspectives within the context of online learning.

Providers agree that MOOCs can be helpful for disabled learners, for example, for CPD, to improve career and study opportunities through acquiring new competencies, and options for certification that MOOCs offer. MOOCs allow social integration in allowing disabled learners to socialise with other learners. MOOCs enable disabled learners to work in their environment (place) and at their own rhythm or pace, facilitating self-regulated learning. The openness and low cost of MOOCs are value-added features for those learners who face socio-economic disadvantages.

Providers understand several factors affect disabled learners while participating in MOOCs. One of these factors is use of Web technology; providers are aware if technology is not applied correctly it can create new accessibility barriers. Another factor is that massiveness is a bridge to inclusiveness: a learning community is inclusive; and massiveness allows diversity, supporting people from many countries, ages and different backgrounds. Finally, providers are aware that legislation is driving accessibility. Their priority is to meet the standards and legislation to avoid legal issues, and, so, MOOC providers do not think on accessibility as a service to the learner but as a means to meet the legislation.

There is a lack of understanding of the number of disabled learners engaging with MOOCs. The standard way to get to know participation information is via surveys at the beginning or the end of the MOOCs and when learners report any accessibility barriers, or via feedback forms or using comments feature in the online environment. In most MOOC surveys, very little demographical information is enquired. In some cases, course providers show awareness of accessibility in their courses, although when discussing with them, it was observed accessibility and disability in their terms is linked to physical disabilities and generally visual impairment.

To understand how MOOC providers cater for disabled learners, there need to be mechanisms for learners to report accessibility barriers: (theme *"MOOC educational enablers"*, sub-theme *"Help: Report and feedback"*). In that sense, providers need to focus on how easy it is for learners to find online help, report accessibility barriers, and get/provide feedback. Providers indicate the use of forums as a tool for asking for help from peers and realise that providing options for help can increase learners' engagement and in improving the learning experience. However, course team members encourage learners to report accessibility barriers with the platform to platform providers, because they tend to encourage the use the forums as a way to find accessibility barriers related to educational resources.

RQ3. How can MOOCs be made accessible for disabled learners? - RQ3a. What is the current state of accessibility of MOOCs?

The theme *"Organisational accessibility processes"* (*"Legislation and standardisation", "Accessibility protocols, guidelines and quality assurance", "Accessibility training, testing and auditing"*) helps in understanding of the current state of accessibility of MOOCs. Legislation and standards play an everyday role in the organisational processes of both platform and course providers. There are a variety of standards, but the lack of unification creates difficulties in application of these standards. The legislation is not necessarily being followed, although there is an awareness of its existence and an intention to meet the legal requirements.

Platform providers may need to be aware that legislations of several countries are involved. The platform has its own legal framework and the courses can come from providers around the world with different legislations. The platforms set up in countries with a strong regulation on accessibility enhance accessibility. Platforms should support worldwide-usage, independent of the local legislations.

Platform providers are required to check accessibility during the software development of the platform and have their internal accessibility protocols and guidelines. There is a lack of consistency between providers' accessibility guidelines. Platform providers in some cases provide guidelines and training to course providers. Therefore, the responsibility mostly lies with the course providers to consider accessibility.

The course providers have different levels of knowledge of accessibility while producing educational resources and there is a different understanding of accessibility between organisations. Some organisations have their own guidelines while others use the platform-specific ones. In some cases, the course team deals directly with accessibility, while in some other organisations, course teams are not necessarily aware of

accessibility. Some platform providers develop accessibility guidelines and provide training to the course providers, but the responsibility to cater for accessibility mostly lies with the course providers.

RQ3. How can MOOCs be made accessible for disabled learners? - RQ3b. How can accessibility barriers in MOOCs be identified and addressed?

Focusing on the learning process, there are two factors for MOOC providers that influence the accessibility (theme *"MOOC learning processes"*, sub-themes *"Openness and Massiveness"*, *"Learning design and experience"*):

- **Openness and Massiveness**. Some opinions reflect an assumption that accessibility is increased if openness is increased, and so openness can be a vehicle for accessibility. Massiveness can also help accessibility because of greater access to analytics that can identify different situations of disabled learners.
- **Learning design and experience.** The learning and pedagogical designs should cater for accessibility. Providers show an understanding that the quantity of material delivered each week and the schedule learners can follow influences their learning experience. When producing educational resources different aspects like the use of language and cultural backgrounds need to be considered.

For the theme *"Organisational accessibility processes" ("Accessibility barriers improvements and information", "Adaptation, profiling and recommendation"*) there are several aspects for identifying and addressing accessibility barriers. It can be difficult to draw a line between the accessibility responsibilities of platform and course providers, for example for the accessibility testing of the educational resources. However, course providers are the ones who have produced the resources and will have the responsibility to fix them if accessibility barriers are found. Both platform and course providers agree on the need to develop processes to improve accessibility by including accessibility in the early production of educational resources and platforms.

For that purpose adequate authoring tools need to be provided to the course providers to facilitate accessibility being integral to the design and development of educational resources. They need tools that can help them to produce and upload the educational resources by considering accessibility aspects and by using accessibility checklists to review before the material can be delivered to the platform. For example course providers invest lots of money in video production, and there is a lack of understanding that not all learners enjoy them or find them accessible, and some may prefer to read text or could only access text.

MOOC providers understand that showing accessibility information up front at the beginning of the MOOC can be useful to learners, presented as advice, and not as a limitation to taking part in the course. The use of accessibility profiling options in MOOCs can help to show the information related to learners' needs, and personalisation may allow recommending MOOCs depending on their preferences and accessibility needs/constraints.

To be able to identify the accessibility barriers, it is important to consider the different aspects of the educational enablers in MOOCs (theme *"MOOC educational enablers"*, sub-themes *"Platform design and access", "Educational resources", "Discussion, assignments, tests and quizzes", "Help: Report and feedback"*):

- **Platform design and access.** The design of the MOOC platform needs to be simple and customisable; learners need to know where they are at each interaction. There is no need to add too many features, but the design should facilitate different learning paths depending on learner's preferences. Access should not depend on a good internet connection; there need to be options for offline access to content.

- **Educational resources.** The educational resources need to provide accurate subtitles and transcripts, with features to cater for language and cultural barriers also playing a role. Course providers should provide different learning experiences with multiple educational resources. The length of videos and clarity of the language used in them should be relevant. The content should be audio described and include subtitles and provide sign language which can be activated or deactivated by the learner.

- **Discussion, assignments, tests and quizzes.** The assignments, tests and quizzes can add to accessibility barriers and increase the dropout rate. Discussions in forums should be designed in a way that they are easy to follow; and assignments and quizzes should be optional and should provide feedback.

- **Help: Report and feedback.** The platform providers should ensure that there are options for help to report barriers, for example providing help buttons that are always available.

Review of the RQs answered in this study

Although Smith et al. (2017) provided an overview of the process of developing MOOCs from academics' experiences, there is limited research to understand the accessibility development processes in MOOCs as discussed in **section 2.6**. MOOC providers cater for disabled learners and they are sensitised to their needs. However, it is not known who is participating in MOOCs as providers are not tracking the audience who are taking up their courses. The lack of information makes it difficult to design educational resources that consider different target groups and provide preferences for personalisation of the learning experience. There is a lack of data on disability in online learning, either via building profiles or during registration processes (Perryman & de los Arcos, 2016), the interviews in this study have indicated that MOOCs are not an exception; although the potential use of this data has previously been identified (Porter, 2014). The low level of commitment required to study a MOOC creates additional difficulty in capturing rich data (Littlejohn et al., 2016).

The number of unemployed disabled learners in the labour market is higher than non-disabled learners, as reported by Powell (2018). Providers think MOOCs can be helpful for disabled learners for CPD and certification, a benefit reported by Dennen & Bong (2017) for all learners which is facilitated by the openness and low cost in MOOCs. As Wong et al. (2015) report, MOOCs allow interactivity. There is an agreement between providers that social interaction allowed in MOOCs permits disabled learners to socialise and to increase their self-regulated learning. Massiveness can be a bridge to inclusiveness, enabling diverse learners from different cultural backgrounds to participate in MOOCs.

One of the main aspects identified is the disparity of processes that exist between providers. MOOC platforms depend on legislation, and that is driving accessibility. So, disabled learners are not the priority when developing platforms and courses, rather it is to meet the standards and legislation requirements. Therefore, providers are aware that technology can be an accessibility barrier, and that allowing more flexibility and personalisation in MOOCs can be a solution. This perspective is supported by Daniel, Cano, & Cervera (2015) who question the viability of personalisation within the current MOOC business model. Providers indicate it should be easier for learners to find help, report accessibility barriers, get feedback and access mechanisms to help each other. Getting a better understanding of learners feedback can help to support accessibility (Coughlan et al., 2017).

Authors like Haavind & Sistek-Chandler (2015) and Papathoma (2019) reported the limited training course providers have in MOOC development. Other authors like Sanchez-Gordon & Luján-Mora (2016c) and Sanderson et al. (2016) explained the use of authoring tools to create and edit MOOC accessible educational resources. As we have seen in this section interviewing MOOC providers in the study being reported in this chapter has helped to develop a better understanding of the accessibility internal processes in the creation of platforms and educational resources. This has allowed having a deeper perspective of MOOCs providers on accessibility.

4.8 Conclusions

This chapter focused on what the MOOC providers perceive regarding accessibility - their understanding of disabled learners participating in MOOCs (**RQ1**) and the processes to make MOOCs accessible (**RQ3**).

The second study (Study B) seeks to capture disabled learners' views of MOOCs. Study B is presented in the next two chapters: the data from online surveys is reported in Chapter 5, and data from the interviews is discussed in Chapter 6.

5. Study B: The perspectives of disabled learners (online surveys)

Chapter 5 and chapter 6 together describe study B, conducted to capture the perspectives of disabled learners. The study has a mixed methods design comprising analysis of existing online surveys and interviews with disabled learners. This chapter describes the perspectives of disabled learners elicited through analysis of online surveys. The study with disabled learners is complements study A carried out with MOOC providers in order to understand the accessibility in MOOCs.

5.1 Introduction

This chapter describes Study B in terms of its overall design (**Section 5.3**) then introduces the design of the online surveys in **Section 5.4**. The surveys data collection and the applied analysis is shown in **Sections 5.5 and 5.6**, followed by in the research findings (**Section 5.7**), the discussion (**Section 5.8**) and main conclusions (**Section 5.9**).

5.2 Research questions

In this study two research questions are addressed (**Section 2.7**):

- **RQ2**. What are the motivations of disabled learners when taking part in MOOCs?
- **RQ3**. How can MOOCs be made accessible for disabled learners?
    - **RQ3a**. What is the current state of accessibility of MOOCs?
    - **RQ3b**. How can accessibility barriers in MOOCs be identified and addressed?

5.3 Study B design

There are two research objectives in this study related to the research questions: to understand the motivations of disabled learners while participating in MOOCs (**RQ2**), to identify accessibility barriers from their own experiences as learners and help to solve them with the final objective to increase MOOCs accessibility (**RQ3**).

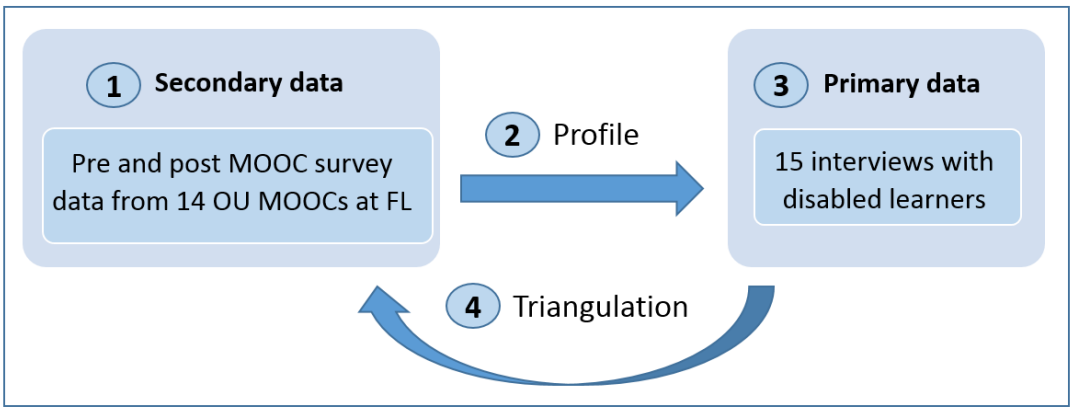

Figure 5. 1. Study B Design

For this study two sources of data have been used: 14 existing online pre and post-course surveys belonging to the OU in FL, with over 29,000 respondents to the pre-surveys and over 5,000 to the post-surveys, and interviews with 15 disabled learners. As a mixed methods research design the primary data are those of the interviews, while the survey data is secondary data. Survey data were analysed first and served to draw initial findings and all triangulation after analysing the interviews (Creswell & Clark, 2017) (**Figure 5.1**).

The pre-course survey in FL is included in the automatic *"thanks for joining"* email that new joiners receive when they enrol on a MOOC and the post-course survey is included in the *'farewell'* email. The learners' IDs for these two surveys would ideally be expected to be the same and so make it possible to match up learners' responses in the pre- the post-course surveys. However, the way OU's SurveyMonkey[58] account was set up in FL, each learner's ID was different in the surveys. This aspect has influenced the design of this study as data from pre and post-course survey is not linked for the analysis of surveys. This limited the analysis of the survey data to be descriptive and avoiding the use of other data sources such as activity data (**Sections 3.5, 3.7 and 9.5**). Some linking was possible using the email address of the participants for the interview recruitment process (access to this sensitive information was granted ethically, **Section 3.8**).

These online surveys were existing and so have not been developed by the researcher and the questions are not designed for the purpose of this research. However, the surveys contain relevant questions for the proposed methodology and have been used to (**Figure 5.1**):

- Draw initial findings for **RQ2** and **RQ3** (**Section 5.7**)
- Develop a profile and contact learners for the interviews (**Sections 6.2.1 and 6.3**)
- Triangulate the findings from the interviews (**Section 6.6**)

The approach used to analyse online surveys has been descriptive and comparative between disabled and non-disabled learners (**Section 5.6**). The profile helped the design of the interviews (**Section 6.2.2**) and the recruitment of the learners (**Section 6.3.1**), where a Person-Centred Planning (PCP) approach has been used (Wilson et al., 2016); this approach to recruitment facilitated contacting experienced MOOC learners who had identified that they had a disability.

The survey data would also some recruitment of a control group to compare experiences between disabled and non-disabled learners (**Section 3.7).** However, a control group was not used in line with the pragmatic research approach and focus on understanding the different realities of disabled learners, acknowledging as Richardson (2017) indicates the limitations of grouping together all "*disabled learners*" and the need to understand their experiences and attitudes are different. For that reason, the priority was to produce a heterogeneous sample of disabled learners to be interviewed (**Section 6.3.2**). The same rationale was used while collecting (**Section 5.5**) to gather online survey data from MOOCs across different subjects. The sampling and recruitment approaches are aligned with the research design (**Section 3.3**)

[58] SurveyMonkey, https://www.surveymonkey.com/

5.4 Design of the online surveys

The OU has standardised pre and post-course surveys in their FL MOOCs. The surveys' design is based on the generic course survey design developed internally by the OU and its OER Research Hub[59], which researches the impact of OERs on teaching and learning practices. No constructs were considered when the surveys were developed, or any validation work or scoring guidance on the constructs was provided (Neuman & Robson, 2014), limiting the options to analyse them by the researcher. The surveys include questions related to disabilities and their educational interests and goals. Disability markers used in this data are based on the ones used for HESA reporting at the OU and so align with a medical model of disability.

Once the structure of the surveys was available to the researcher, the first step was to identify those questions that were relevant for the study and therefore to the research questions. The pre-course survey had 21 questions, while the post-course had 39. The surveys were designed with both open and closed questions. The 4 open questions in the pre-course and 7 open questions in the post-course survey were excluded, as explained further in the data analysis (**section 5.6**). Selection of relevant closed questions resulted in 11 from the pre-course and 18 from the post-course seen as having relevance to the research. **Table 5.1** shows the structure of the data selected for the study, applying labels and structure that have been created by the researcher from the available questions respecting their original order, with the exception that the demographic information questions have been moved to the beginning.

Table 5. 1. Different topics in the surveys selected for the study

	Topics		Number of questions
Pre - Course survey	1	Demographic information	7
	2	Location	1
	3	Areas of interest and previous experience	3
Post - Course survey	1	Devices	1
	2	Previous knowledge and motivation	2
	3	Completion	2
	4	MOOC design	4
	5	Learning experience	5
	6	Course Team	2
	7	Overall evaluation and future actions	2

This structure is also used to design the learners' profile for the interviews (**Section 6.2.1**). The survey questions corresponding to the topics in **Table 5.1**, including questions type (e.g. multiple choice, single or multiple answer, selection list or Likert) and available answers are detailed **in Appendix 5**.

5.5 Data collection

Data was gathered from and the Open Media and Informal Learning Unit (OMIL)[60] which commissions content and manages the production of OER within the OU several platforms, the process took from August until November 2016. OMIL also provided support and mentoring in the use of the data. Following Sapsford & Jupp (1996) the sampling units used for the surveys are online learners, the sampling frame is participants

[59] OER Research Hub, http://oerhub.net/
[60] OMIL, http://www.open.ac.uk/about/open-educational-resources/home/open-media-and-informal-learning

in OU MOOCs at FL and the sampling method was simple random sampling since it was not possible to know the population beforehand. To allow the representation of different groups a large sample size was used.

FL defines full participation as *"a learner completing the majority of steps and all of the tests"* [61] and enrolled are *"learners who signed up"*. **Table 5.2** shows the high numbers of enrolled learners and the percentage of those who completed the MOOC in the first three presentations of the MOOCs. In general, it is observed that the first presentation of the MOOC has higher enrolment than the following ones (second presentation and third presentation). In all cases where fully participating learners (FPL) data is available the MOOCs the FPL are higher in the first presentation than in the rest. The richest data are those from the first presentation of the MOOC, and so that was the data requested from OMIL.

Initially, the selected sample included 20 MOOCs. The MOOCs: *"Forensic Psychology"*, "*The Science of Nuclear Energy"*, *"Managing my Investments"*, *"Childhood in the Digital Age"*, *"Challenging Wealth"* and *"Income Inequality"* did not follow the survey structure provided beforehand to the researcher being discarded, reducing the sample in 14 MOOCs.

Table 5. 2. Information about the presentations

Name of the MOOC	Weeks	FP Date	FP Enrolled learners	%FPL	SP Enrolled learners	%SPL	TP Enrolled learners	%TPL
Basic Science: Understanding Experiments	4	Sep-14	6,903	9%	5,566	7%	3,775	8%
Elements of Renewable Energy	4	Jan-15	6,831	16%	7,963	13%	6,125	10%
Get Started with Online learning	2	Aug-15	8,771	17%	7,041	12%	4,241	9%
Introduction to Cyber Security	8	Oct-14	24,330	18%	21,006	14%	14,799	12%
Introduction to Ecosystems	6	Nov-13	11,264	15%	7,499	9%	5,002	8%
Learn to code for data analysis	4	Oct-15	19,779	3%	9,429	N/A	262	N/A
Managing my Money	8	Apr-14	15,379	9%	19,466	6%	18,913	2%
Moons	8	Mar-14	8,044	18%	11,374	11%	7,598	7%
Smart Cities	6	Sep-15	8,007	8%	6,483	8%	4,972	N/A
Start Writing Fiction	8	Apr-14	25,848	14%	25,876	14%	23,470	9%
The Business of film	6	Oct-15	9,097	7%	3,405	N/A	49	N/A
The Lottery of Birth	4	Aug-15	6,058	15%	3,069	11%	926	N/A
The Science of Nutrition	4	Sep-15	18,785	12%	18,407	12%	6,409	N/A
Understanding Musical Scores	4	Aug-15	6,588	22%	4,160	16%	1,377	N/A
		Total	**175,684**	**13%**	**150,744**	**11%**	**97,918**	**8%**

[61] Full participation https://about.futurelearn.com/blog/measuring-our-first-eight-courses

The sample included MOOCs from 2013-2015 and covered a range of HESA subjects and FL categories as **Table 5.3** shows; as defined in **Sections 3.3** and **5.3** the objective was to cover a broad variety of subjects in the sample.

Table 5. 3. Sample disaggregated by name of the MOOC, subject and category

Name of the MOOC	Subject – HESA	FL online course category
Basic Science: Understanding Experiments	Physical Sciences	Science, Engineering & Maths Courses
Elements of Renewable Energy	Physical Sciences	Nature & Environment Courses
Get Started with Online learning	Education	Teaching Courses
Introduction to Cyber Security	Computer Sciences	Tech & Coding Courses
Introduction to Ecosystems	Biological Sciences	Nature & Environment Courses
Learn to code for data analysis	Computer Sciences	Tech & Coding Courses
Managing my Money	Mathematical Sciences	Science, Engineering & Maths Courses
Moons	Physical Sciences	Science, Engineering & Maths Courses
Smart Cities	Architecture, Building & Planning	Politics & the Modern World Courses
Start Writing Fiction	Creative Arts & Design	Languages & Cultures Courses
The Business of film	Business & Administrative Studies	Business & Management Courses
The Lottery of Birth	Historical & Philosophical Studies	History Courses
The Science of Nutrition	Medicine & Dentistry	Health & Psychology Courses
Understanding Musical Scores	Creative Arts & Design	Creative Arts & Media Courses

The total number of learners who completed the pre-course survey was 29,433, the number of learners who considered themselves as disabled was 3,343. A smaller number completed the post-course surveys where the total amount was 5,629, and the number of disabled learners was 687. **Table 5.4** shows the information disaggregated by MOOCs. In all courses, the number of learners who completed the post-course survey is smaller than the pre-course survey. *"Get Started with Online Learning"* has the biggest percentage of disabled learners with 15.7% (pre) and 15.2% (post) while *"Smart Cities"* has the smallest percentage with 2.9% (pre) and 5% (post).

Table 5. 4. Pre-and post-course survey participation

	Pre-Course Survey			Post-Course Survey		
Name of MOOC	**Total**	**Response rate**	**%DL**	**Total**	**Response rate**	**%DL**
Basic Science Understanding Experiments	804	11.6%	20.9%	163	2.4%	13.3%
Elements of Renewable Energy	974	14.3%	11.3%	150	2.2%	11.6%
Get Started with online learning	1668	19%	15.7%	280	3.2%	15.2%
Introduction to Cyber Security	6,065	24.9%	9.9%	1,049	4.3%	9.4%
Introduction to Ecosystems	734	6.5%	12.1%	240	2.1%	13.1%
Learn to code for data analysis	3,454	17.5%	7.6%	158	0.8%	8.8%
Managing My Money	1,401	9.1%	12.4%	394	2.6%	13.1%
Moons	1,251	15.5%	12.2%	935	11.6%	11.8%
Smart Cities	1,020	12.7%	2.9%	137	1.7%	5%
Start Writing Fiction	5,215	20.2%	16.0%	714	2.8%	14.2%
The Business of Film	977	10.7%	9.6%	240	2.6%	8.3%
The Lottery of Birth	1,426	23.5%	7.3%	96	1.6%	13.5%
The Science of Nutrition	2,813	14.9%	12.0%	702	3.7%	10.5%

	Pre-Course Survey			Post-Course Survey		
Understanding Musical Scores	1,631	24.8%	14.0%	371	5.6%	12.8%
Total	**29,433**	**16.1%**	**12.2%**	**5,629**	**3.4%**	**11.3%**

The total percentage of disabled learners participating in the surveys was 12.2% (pre) and 11.3% (post). Note these percentages are smaller than the percentage of disabled students at the OU, which was 18.5% in 2017/18 (The Open University, 2018b), and also lower that the 19% of users of OpenLearn (Law et al., 2013) and at world level (WHO, 2011) as reported in the literature review (**Section 2.3**).

Following Nulty (2008) the class size and response rates shown in the previous **Table 5.4** is valid and reliable for *"liberal conditions"* (>1%, 10% sampling error) but has limitations for *"stringent conditions"* (>25%, 3% sampling error) which is the case of a diverse sample. The response rates are in line with those found in literature in MOOCs (Christensen et al., 2013; Liyanagunawardena & Williams, 2016). The difference in response rates between pre and post-course survey respondents is significant, this is aligned with the dropout rates in MOOCs (Guo & Reinecke, 2014; Hood & Littlejohn, 2016). From those respondents, learners who finish the MOOC and fill in the post-course survey may show biases across satisfaction, self-selection or non-response (Pursel et al., 2016).

A simple self-reported disability marker may not reflect the diversity within the population and so groups can be over or under-represented. Therefore it is not appropriate to draw general inferences (Neuman & Robson, 2014) and it should not be assumed that the data generalise to the whole of the disabled learner population, or that this population is homogenous (Richardson, 2017). Limitations are discussed further in **Section 9.5**.

5.6 Data analysis

The data of the 14 different surveys have been joined in a single file for the pre-course and a single file for the post-course data, to support the use of the statistical analysis software SPSS[62] for the analysis. As commented previously, the online surveys were not designed with constructs that allow building correlations between questions. Therefore, the analysis is descriptive showing the total number of answers and column percentages. Several decisions for the data analysis were taken:

1. **Open questions.** As indicated in the study design (**Section 5.4**), open questions were considered as part of the data source from surveys. From all the learners who self-identified as disabled in the surveys, those 11 questions were extracted and added into an Excel file. Answers were cleaned and manually reviewed by the researcher concluding they were not adding relevant information to answer the research questions, and so discarded for the study.

2. **Duplicate cases.** Regarding the treatment of duplicate cases the respondent ID is unique, therefore it is not possible to identify two duplicated cases, assuming its possibility but a low probability.

[62] SPSS, https://www.ibm.com/analytics/spss-statistics-software

3. **Duplicate questions.** Duplicated questions in both surveys were considered.

4. **Missing values**. No partially filled surveys were stored, therefore all the surveys are from those who submitted complete surveys. Missing responses or those who have been coded as *"prefer not to say"* to the *"Do you consider yourself to have a disability"* question have been excluded.

5. **Non-relevant answers**. Answers which were not relevant to the research (**Section 5.4**) (e.g., answers focused on the academic context of the OU) have been excluded from the profile and the analysis.

6. **Grouped answers.** Answers from some questions have been grouped, such as country of residence (the UK and overseas) and first spoken language (English and non-English).

7. **Question types.** Information about the questions: multiple choice (single or multiple answer), selection list or scale (Likert) and all possible response values can be consulted in **Appendix 5**. Note for the scale questions only extreme values are shown (e.g. strongly like vs strongly dislike).

8. **Test and significance.** For the analysis a binary variable to identify answers to *"Do you consider yourself to have a disability"* question was created. For the survey data discussed in the research findings, **Section 5.7**, tables show the percentage of positive responses for the total of learners, non-disabled and disabled. Pearson's Chi-Squared test of independence is added in a column to show the association between the variables applying Phi and Cramer's V nominal association. The response levels are compared in percentages between non-disabled and disabled learners where significance is indicated by * at $p<0.01$ using z-test for its convenience between pairs of means (Calder, 2006). P-value is adjusted for multiple comparisons using the Bonferroni method.

5.7 Research findings

The findings are presented using the topics introduced in the design of the online surveys (**Section 5.4**) as given in **Table 5.1**.

5.7.1 Demographic information

Table 5.5 shows the presence of female learners was greater in those who declare disabilities (58.9%*). The presence of learners from 16 to 45 years was greater for non-disabled learners, particularly in the interval from 26-35 (21.3%*), disabled learners had more presence over 45 years and particularly in the interval 56-65 (21.4%*) and over 65 (13.9%*). The presence of native English speakers was greater for disabled learners up to 88.9%* of the sample, and a higher proportion of the disabled learners were based in the UK (73.5%*).

Table 5. 5. Demographic information for gender, age, country and language

What is your gender?	%Total	% N-D	% Disabled	Pearson X-2
Male	47.0%	47.7%	41.1%	56*
Female	53.0%	52.3%	58.9%	38.1*
Total	**28,077**	**24,962**	**3,115**	
Which country do you live in?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**

UK	58.7%	56.8%	73.5%	341*
Overseas	41.3%	43.2%	26.5%	352*
Total	**29,433**	**26,090**	**3,343**	
What is your first spoken language?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**
English	73.0%	71.0%	88.9%	481*
Non-English	27.0%	29.0%	11.1%	495*
Total	**29,433**	**26,090**	**3,343**	
What is your age?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**
< 16 years	.8%	.8%	1.1%	2
16-18 years	2.5%	2.6%	2.3%	0.4
19-25 years	11.1%	11.4%	8.8%	19.7*
26-35 years	20.5%	21.3%	14.7%	72.7*
36-45 years	18.5%	18.8%	16.6%	12.9*
46-55 years	19.4%	19.2%	21.1%	6.5
56-65 years	16.5%	15.8%	21.4%	69.1*
Over 65 years	10.6%	10.2%	13.9%	47.9*
Total	**27,957**	**24,822**	**3,135**	

Table 5.6 offers information related to the educational background and employment status. Disabled learners had greater proportions among those learners with no formal qualification (4.8%*), a school-leaving qualification (7.2%*, 8.0%*) and college diploma (17.6%*) while non-disabled learners reported having a postgraduate degree or doctorate in higher proportions (32.1%*, 4.4%*). There were similar proportions of undergraduate disabled and non-disabled learners.

Table 5. 6. Demographic information for educational qualification and employment

What is your highest educational qualification?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**
No formal qualification	2.1%	1.8%	4.8%	116*
School-leaving qualification (16 years)	5.1%	4.9%	7.2%	28.3*
School-leaving qualification (18 years)	6.6%	6.4%	8.0%	10.2*
Vocational qualification	3.6%	3.4%	5.4%	32.6*
College diploma	13.5%	13.0%	17.6%	56.3*
Undergraduate	33.7%	33.9%	31.9%	7.4
Postgraduate	31.0%	32.1%	22.4%	129.9*
Doctorate	4.4%	4.6%	2.6%	28.4*
Total	**28,271**	**25,103**	**3,168**	
What is your employment status?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**
Full-time employed	49.0%	51.6%	28.1%	604*
Part-time employed	15.0%	15.1%	14.0%	3.03
Full-time voluntary work	.6%	.5%	.7%	1.7
Part-time voluntary work	1.3%	1.2%	2.3%	27.8*
Full-time student	7.3%	7.4%	6.0%	9.3
Part-time student	1.3%	1.2%	1.9%	10.1*
Unwaged and seeking employment	4.3%	4.3%	4.4%	0

Unwaged with domestic responsibilities	2.8%	2.6%	4.1%	20.3*
Disabled and not able to work	1.9%	.1%	16.1%	3831*
Retired	16.6%	15.9%	22.4%	79.7*
Total	**27,828**	**24,693**	**3,135**	

Regarding the employment status, there was a significant difference between those non-disabled learners reporting higher percentages in full-time employment (51.6%*) with the disabled learners reporting higher levels of unwaged with domestic responsibilities (4.1%*) and retired (22.4%*), this proportion could be related to the predominance of mature disabled learners shown in **Table 5.5**. There are similar percentages in the sample between those disabled and non-disabled learners who were part-time employed and unwaged and seeking employment. The employment difference could be due to the higher number of unemployment between disabled, as Powell (2018) indicates the percentages of employment in the British labour market are 81.4% for non-disabled and 51.3% for disabled

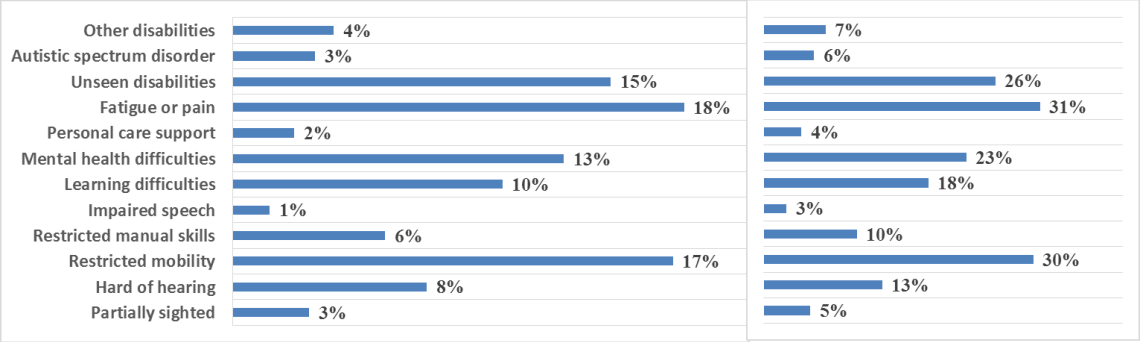

Figure 5. 2. Disabled learners by categories of disability in percentage and percentage of cases

Figure 5.2 indicates the sample of disabled learners in the pre-course survey disaggregated by categories of disability. The total number of disabilities declared by learners totalled to a percentage of cases of 176%, this number reflects that may disabled learners declare more than one disability as also reported for OU students (The Open University, 2018a). The most declared disabilities are fatigue or pain (18%), restricted mobility (17%) and unseen disabilities (15%).

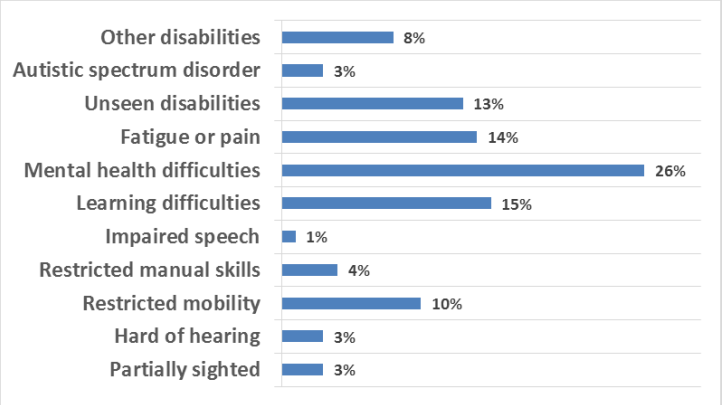

Figure 5. 3. Disabled learners by categories of disability at the OU

Comparing this data with percentages from OU students' data as shown in **Figure 5.3** (The Open University, 2018b): mental health (26%) and learning difficulties (15%) are predominant, while fatigue or pain (14%), restricted mobility (10%) and unseen disabilities (13%) are comparable to this study sample.

5.7.2 Location - Areas of interest and previous experience

Table 5.7 summarises the location where learners were willing to participate in the MOOCs. There was a predominance of choosing to take them *"at home"* (96%*), for disabled the proportion of those choosing to participate *"at work"*, *"at school"* or *"while on the move"* was smaller than non-disabled (19.9%*, 5.1%* and 8.9%*).

Table 5. 7. Information about the location

Where do you expect to do the course?	%Total	% N-D	% Disabled	Pearson X-2
At work	19.0%	19.9%	12.2%	112.9*
At school / college / university	4.9%	5.1%	3.5%	16.4*
At home	94.6%	94.4%	96%	11.18*
In a public place	9.6%	9.4%	10.8%	6.1
While on the move	8.7%	8.9%	7.4%	7.7*
Total	**29,229**	**25,915**	**3,314**	

Reasons for interest in studying MOOCs had higher percentages for disabled learners for their *"personal interest"* (88.2%*), *"the course was free"* (45.9%*), to *"try out online learning"* (26.0%*), *"prepare for my future study"* (20.8%*) and *"to find out if I can study at this level"* (12.5%*). While its percentages were lower when answering *"relevant to their work"* or *"for professional development"* (19.2%, 29.9%). Similarly, in previous experience using online courses for *"online course for university credit"* or *"OER"* was higher percentage for disabled learners but not *"for continuing professional development"* (29.6%) (**Table 5.8**).

Table 5. 8. Interests and previous experience

Why are you interested in studying this course?	%Total	% N-D	% Disabled	Pearson X-2
Personal interest	85.2%	84.8%	88.2%	23.4*
Professional development	39.1%	40.2%	29.9%	139.9*
Relevant to my work	26.8%	27.8%	19.2%	112.1*
Relevant to my current studies	11.5%	11.4%	12.7%	4.7
To prepare me for future study	17.1%	16.6%	20.8%	35.4*
For the purpose of teaching others	9.2%	9.3%	8.8%	1
For the purpose of sharing with others	15.5%	15.2%	17.7%	13.5*
Relevant to voluntary work	5.4%	5.1%	7.7%	39.5*
To improve my English	10.7%	11.2%	6.9%	57.6*
To find out if I can study at this level	8.3%	7.7%	12.5%	88.9*

Why are you interested in studying this course?	%Total	% N-D	% Disabled	Pearson X-2
To find out more about MOOCs	11.4%	11.1%	13.4%	14.4*
The course was free	38.4%	37.5%	45.9%	86.6*
To try out learning online	22.1%	21.7%	26.0%	31.6*
To learn more flexibly around my other commitments	22.0%	21.6%	25.1%	20.2*
Total	**29,303**	**25,979**	**3,324**	
What sort of online course have you taken?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**
An online course for continuing professional development	33.5%	34.0%	29.6%	11.3*
A MOOC	65.1%	65.2%	64.3%	.03
An online course for university credit	23.3%	22.4%	30.4%	72.9*
An online course based around OER	18.4%	17.7%	23.9%	53.4*
Total	**19,671**	**17,403**	**2,268**	

Participation with other providers in **Figure 5.4** in response to the question *"Have you studied an open course with any of these providers?"*, showed no significant differences, though the percentage of disabled learners was higher in OpenLearn while non-disabled percentages were higher in edX and Coursera.

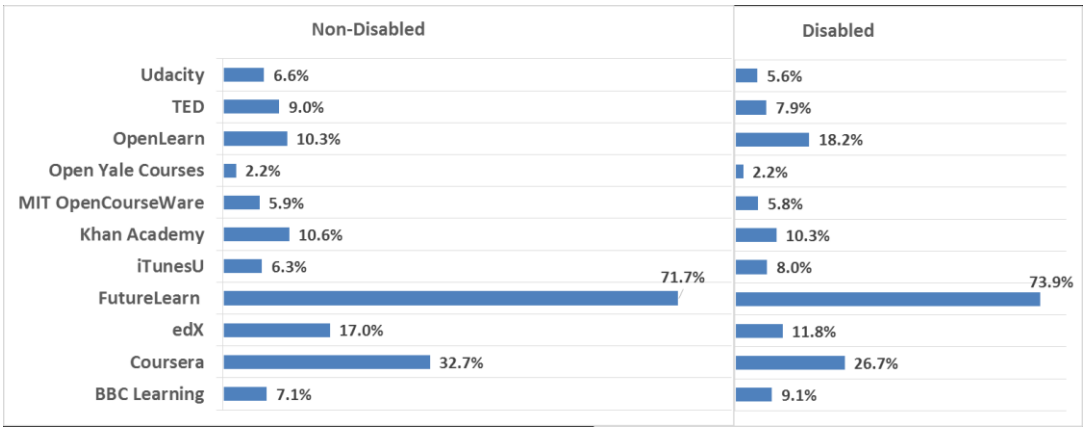

Figure 5. 4. Previous experience with open course providers

5.7.3 Devices - Previous knowledge and motivation

The laptop was the primary device used by disabled learners (44.5%) followed by the desktop computer (37.7%), with the higher percentage of use of the tablet by disabled learners significant (20%*) (**Table 5.9**).

Table 5. 9. Information about the main device used

Which devices did you use to study the course?	Main device			
	%Total	% N-D	% Disabled	Pearson X-2
Tablet	15.4%	14.7%	20.0%	136*
Desktop computer	37.6%	37.6%	37.7%	13.6
Smartphone	3.6%	3.6%	3.8%	1.1
Laptop	48.8%	49.4%	44.5%	7.7

Which devices did you use to study the course?	Main device			
	%Total	% N-D	% Disabled	Pearson X-2
Total	**5,577**	**4,896**	**681**	

Table 5.10 shows approximately over 70% disabled learners at least "have some experience" in the subjects selected in MOOCs (50.8%), though that does mean that a sizeable proportion had *"little or nothing"* knowledge in the subject before joining the MOOC (28.3%). Other areas with significant differences were a greater percentage of disabled learners *"at school level qualification in the area"* (9.3%*), and a greater percentage of non-disabled learners with *"working experience"* (11.2%*).

Table 5. 10. Previous knowledge and motivation approaching the MOOC

How much did you know about the subject of this course when you started?	%Total	% N-D	% Disabled	P X-2
Little or nothing	26.4%	26.1%	28.3%	1.4
Some experience	51.9%	52.1%	50.8%	.4
I have taken another free online course in this area	6.7%	6.7%	6.6%	.1
I have a school-level qualification in this area	5.8%	5.3%	9.3%	18.2*
I have a university-level qualification in this area	7.4%	7.4%	7.7%	.95
I work in this area or have worked in this area	10.7%	11.2%	7.2%	10.5*
I am an expert in this area	.8%	.8%	.7%	.05
I teach in this area or have taught in this area	2.5%	2.4%	3.2%	1.5
Total	**5,624**	**4,939**	**685**	
Which phrase best describes your approach to the course	**%Total**	**% N-D**	**% Disabled**	**P X-2**
I was highly motivated	33.1%	32.4%	38.3%	8.7*
I was motivated	51.7%	52.3%	46.9%	7.3*
I was motivated some of the time	12.4%	12.6%	11.0%	1.2
I struggled to stay motivated	2.5%	2.3%	3.7%	4.9
I wasn't really motivated	.4%	.4%	0%	2.7
Total	**5,520**	**4,849**	**671**	

Disabled learners were *"motivated*" and *"highly motivated"* while participating in MOOCs (46.9%, 38.3%*).

5.7.4 Completion – MOOC Design

Table 5.11 shows MOOCs completion. All learners who signed up for the MOOC got an email with a link to the end of course survey and so it is logical to think learners who filled in that survey are more likely to have completed it. The highest number was from those disabled learners who took most of the MOOC (80.2%), followed from those who *"worked through some sections in detail"* (8.8%) and those who *"watched what was going on but did not actively participate"* (6.9%).

About the reasons why learners have not taken part in the entire course, there was a significant difference for non-disabled (56.6%*) *"not having enough time"* to finish the MOOC. For 20.2% of the disabled learners the course was *"too basic"*, and for 18.3% they *"did not keep up as the course progressed"*. Significant for disabled learners was *"suffering from ill-health"* (18.3%*) and that there was *"not enough staff support"* (6.4%*).

Table 5. 11. Ways to participate and Reasons for not completion

People work through open courses in different ways. Which of these is most like what you did?	%Total	% N-D	% Disabled	Pearson X-2
I signed up, but didn't get much further	.2%	.2%	.1%	.2
I did a lot in the first week, but not much after that	.9%	1.0%	.7%	.3
I had a quick look at everything	3.2%	3.3%	2.4%	1.8
I worked through some sections in detail	9.1%	9.1%	8.8%	.06
I worked through one section in detail	.6%	.6%	.7%	.2
I watched what was going on, but didn't actively participate	8.9%	9.2%	6.9%	3.7
I worked all the way through the course and did most of the course	77.0%	76.6%	80.2%	3.7
Total	**5,571**	**4,893**	**678**	
If you did not take part in the entire course, why was that?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**
I didn't have enough time	54.1%	56.6%	37.6%	4.1*
I lost interest / motivation	12.3%	11.9%	14.7%	1.2
I didn't keep up as the course progressed	21.8%	22.4%	18.3%	.2
I found the site hard to use	3.0%	2.8%	4.6%	1.4
I'm not used to learning at this level	3.0%	1.1%	3.7%	5
The course was too advanced	2.8%	2.8%	2.8%	.1
The course was too basic	15.3	14.5%	20.2%	3.3
I couldn't access the course materials	**5.2**	4.9%	7.3%	1.6
I didn't have a good enough Internet connection	7.8	8.1%	5.5%	.4
I never really intended to take part – I was just curious	3.9	3.9%	3.7%	.003
I never really intended to take part – I joined the course by mistake	.4%	.3%	.9%	1.2
I was suffering from ill-health	5.9%	4.1%	18.3%	33.7*
There was not enough staff support	2.5%	2.0%	6.4%	8.7*
The course did not meet my learning objectives	5.3%	5.3%	5.5%	.08
Total	**824**	**715**	**109**	

Most of the disabled learners considered the time to be required to complete the MOOC was *"about right"* (81.3%) but looking at those who considered *"a bit too little"* there is a higher proportion for disabled learners (7.1%), as it is for those who considered it *"much too little*" (2.4%*) (**Table 5.12**). The same table shows the responses about the clarity in the structure of the MOOC; most disabled learners considered it *"very clear"* (76.3%), while a low percentage consider the MOOC structure to be *"reasonably unclear"* or *"very unclear"* (1.2%, .3%).

Table 5. 12. Time required and structure of the MOOC

How did you feel about the amount of time required by the course?	%Total	% N-D	% Disabled	Pearson X-2
Far too much	1.0%	1.0%	1.2%	0.2
A bit too much	7.9%	7.9%	8.1%	0.32
About right	84.2%	84.6%	81.3%	5.5
A bit too little	5.6%	5.4%	7.1%	3
Much too little	1.3%	1.1%	2.4%	6.8*
Total	**5,573**	**4,895**	**678**	
How clear did you find the structure of the course?	**%Total**	**% N-D**	**% Disabled**	**Pearson X-2**

Very clear	76.8%	76.9%	76.3%	0.8
Fairly clear	20.9%	21.0%	20.0%	0.3
Neither clear nor unclear	1.6%	1.5%	2.2%	2.1
Fairly unclear	.6%	.5%	1.2%	5.3
Very unclear	.2%	.1%	.3%	0.8
Total	**5,485**	**4,815**	**670**	

Table 5.13 shows the selected words that describe the online discussions; there is a significant proportion for disabled learners for *"encouraging"* (33.8%*) and *"thought-provoking"* (43.1%*). A high proportion considered them *"Interesting"* (77.1%) and *"helpful"* (57.5%). Lower numbers show them as *"boring"* (6.5%), *"confusing"* (5.3%) and *"difficult"* (3.1%).

Table 5. 13. Online discussions and participating in the MOOC

Please select words from the list below that describe the online discussions on the course					**Please select words from the list below that describe the things you were asked to do on this course**			
	%Total	**% N-D**	**% D**	**P X-2**	**%Total**	**% N-D**	**% D**	**P X-2**
Interesting	76.8%	76.7%	77.1%	.3	79.6%	79.2%	82.6%	3.1
Helpful	55.9%	55.7%	57.5%	1.2	57.1%	57.2%	56.3%	.3
Scary	2.7%	2.7%	3.2%	.8	4.1%	4.0%	4.9%	.9
Off-putting	5.2%	5.0%	6.6%	3.3	1.7%	1.6%	2.7%	4.1
Confusing	4.8%	4.7%	5.3%	.5	4.8%	4.6%	5.6%	1.1
Encouraging	29.3%	28.7%	33.8%	8*	27.2%	26.3%	33.6%	15.2*
Important	25.9%	25.6%	27.7%	1.6	36.2%	35.5%	41.4%	8.5*
Boring	6.5%	6.5%	6.5%	.009	3.0%	2.9%	3.8%	1.5
Irrelevant	9.8%	9.9%	8.8%	0.6	7.6%	7.4%	8.7%	1.3
Difficult	2.0%	1.9%	3.1%	4.5	45.2%	44.4%	51.0%	9.7
Stimulating	26.7%	26.3%	29.6%	3.8	2.1%	2.0%	3.1%	3.3
Too long	7.9%	8.0%	6.6%	1.4	2.9%	2.8%	4.0%	2.9
Too short	1.9%	1.8%	2.5%	1.6	47.3%	46.3%	54.1%	13.6*
Thought-provoking	37.3%	36.5%	43.1%	11.8*	35.6%	34.9%	40.3%	6.8
Changed my view	10.2%	10.1%	10.6%	21.2	16.0%	15.5%	19.8%	7.8*
I didn't do them	2.9%	2.8%	3.5%	.2	4.2%	4.2%	3.7%	.4
Total	**5,514**	**4,836**	**678**		**5,578**	**4,900**	**678**	

Similarly for the tasks to undertake during the MOOC (**Table 5.13**), *"thought-provoking"* (54.1%), *"stimulating"* (51.0%), *"important*" (41.4%), *"challenging"* (40.3%), *"encouraging"* (33.6%) and *"changed my view"* (19.8%) are significant for disabled learners. *"Interesting"* (82.6%) and *"helpful"* (56.3%) are highly represented while *off-putting"* (2.7%) and "*boring"* (3.8%) have been less selected.

5.7.5 Learning experience

When rating the way learners felt while participating in FL MOOCs, selecting the most extreme cases of strongly disliked and strongly liked, the percentages of disabled learners who strongly liked *"reading articles"* (57.4% v 13.6%), "*watching videos"* (18.2% v 64.7%), "*doing quizzes and tests"* (13.6% v 61.2%) or

"following links to other related content" (9.1% v 42.5%) are positive, while *"reading comments posted by other learners"* (45.5% v 24.7%) or "*discussing things online with other learners"* (72.7% v 15.3%) had a higher percentage of strong dislikes (**Table 5.14**).

Table 5. 14. Different ways of learning on FL

Please rate from "strongly disliked" to "strongly liked" how you felt about the different ways of learning on FL	Strongly disliked				Strongly liked			
	%T	% N-D	% D	P X-2	%T	% N-D	% D	P X-2
Reading articles	5.1%	3.7%	13.6%	9.5*	56.2%	56.1%	57.4%	0.4
Watching videos	10.8%	9.6%	18.2%	4.1	68.5%	69.0%	64.7%	2.6
Reading comments posted by other learners	46.5%	46.7%	45.5%	0.3	22.1%	21.7%	24.7%	2.7
Discussing things online with other learners	74.8%	75.2%	72.7%	0.4	13.9%	13.7%	15.3%	1.9
Doing quizzes and tests, and getting feedback	11.8%	11.5%	13.6%	0.5	57.8%	57.3%	61.2%	2.9
Following links to other related content	5.7%	5.2%	9.1%	1.7	41.7%	41.6%	42.5%	0.2
Total	**314**	**270**	**44**		**4,653**	**4,083**	**570**	

The experiences shown in **Table 5.15** indicated disabled learners *"enjoyed studying"* (29.7% strongly disliked v 78.6%* strongly liked), *"would recommend this course to others"* (56.8% v 73.6%), *"the quality of the course was good"* (29.7% v 68.6%) and *"this course made me want to study more".* While (51.4% v 39.1%*) did not find *"the feedback helpful"*.

Table 5. 15. Statements about the experience

Please indicate the extent to which you agree with these statements	Strongly disliked				Strongly liked			
	%T	% N-D	% D	P X-2	%T	% N-D	% D	P X-2
I enjoyed studying	31.4%	31.7%	29.7%	0.4	73.8%	73.2%	78.6%	5.3*
The course was intellectually stimulating	45.2%	44.6%	48.6%	2	53.7%	53.2%	57.8%	3.8
The quality of the teaching materials was good	35.1%	36.1%	29.7%	0.6	60.8%	60.2%	65.5%	4.9
The course met my expectations	52.7%	53.5%	48.6%	0.5	54.2%	53.6%	58.0%	3.4
I found the feedback helpful	40.6%	38.6%	51.4%	5	33.9%	33.2%	39.1%	7.1*
I was able to keep up with the workload	38.1%	38.6%	35.1%	0.3	45.9%	45.5%	49.3%	2.8
Overall, the quality of this course was good	35.6%	36.6%	29.7%	0.4	65.6%	65.2%	68.6%	2.2
I would recommend this course to others	49.8%	48.5%	56.8%	3.3	70.8%	70.4%	73.6%	2.1
This course made me want to study more	41.0%	40.1%	45.9%	2.4	54.5%	53.4%	62.0%	12.1*
Total	**239**	**202**	**37**		**4,214**	**3,695**	**519**	

In relation to the expectations, *"overall expectations of the course"* exceeded expectations with significant relevance for disabled learners (39.9% v 71.2%*) and *"learning new things"* (35.0% v 75.5%*), met the expectations for *"supplementing existing studies"* (17.5% v 37.1%*) and *"preparing for further studies"* (34.6%*21.0%) and fell below expectations for *"interacting with other people"* (59.4% v 18.4%) and *"Improving my career prospects"* (15.4% v 14.9%) (**Table 5.16**).

Table 5. 16. Expectations with FL

To what extent did FL meet your expectations in terms of the following?	Fell below expectations				Exceeded expectations			
	%T	% N-D	% D	P X-2	%T	% N-D	% D	P X-2
Supplementing my existing studies	19.3%	19.6%	17.5%	0.4	29.3%	28.1%	37.1%	22.7*
Interacting with other people	48.6%	46.9%	59.4%	12.2*	18.3%	18.3%	18.4%	1.1
Adding a fresh perspective to my current role	16.5%	16.2%	18.9%	2.3	26.5%	26.1%	28.8%	5.2
Learning new things	35.7%	35.8%	35.0%	0.8	69.8%	68.9%	75.5%	17.2*
Preparing for further studies	18.9%	18.5%	21.0%	2	25.8%	24.4%	34.6%	28.9*
Learning more flexibly around my other commitments	12.6%	13.1%	9.8%	0.2	43.5%	42.9%	47.2%	9.4
Improving my career prospects	21.2%	22.2%	15.4%	0.8	11.8%	11.3%	14.9%	8.2
My overall expectations of the course	37.1%	36.6%	39.9%	3	65.5%	64.6%	71.2%	16.7*
Total	**1,022**	**879**	**143**		**2,927**	**2,531**	**396**	

Table 5.17 indicates an increase in learning after the course, *"know a lot more about this subject now"* (53.5%) and to *"know a little more about this subject now"* (41.3%). The responses are similar for non-disabled and disabled learners with no figures showing significant differences.

Table 5. 17. Subject knowledge and the learning compared to other MOOCS

Which of the following statements about your subject knowledge best applies to you?	%Total	% N-D	% D	P X-2
I know a lot more about this subject now	51.2%	50.9%	53.5%	0.9
I know a little more about this subject now	44.8%	45.3%	41.3%	4.1
My knowledge of this subject has not changed	4.0%	3.8%	5.2%	2.2
Total	**5,263**	**4,626**	**637**	
Thinking about your experience on other open online courses (or MOOCs). Which of the following statements about your learning best applies to you?	**%Total**	**% N-D**	**% D**	**P X-2**
I learned more this time	24.3%	20.6%	21.0%	4.3
I learned less this time	5.7%	6.7%	6.6%	1.1
I learned about the same amount this time	30.6%	29.9%	30.0%	0.5
I have studied several of these courses and usually learn more	5.9%	5.7%	5.7%	0.2
I have studied several of these courses and usually learn less	2.4%	2.6%	2.5%	0.6
I did not learn anything from these courses	.2%	.4%	.3%	0.6
I have never studied an open online course or MOOC before	30.9%	34.1%	33.7%	0.7
Total	**5,466**	**4,803**	**663**	

Comparing the experience with other MOOCs, disabled learners indicated being that their first experience in a MOOC *"I have never studied an open online course or MOOC before"* (33.7%), *"I learned about the same amount this time"* (30.0%) and *"I learned more this time"* (21%) while 6.6% report *"I learned less this time"*.

5.7.6 Course Team - Overall evaluation and future actions

Table 5.18 shows the staff support experience among disabled learners; showing no significant difference to the support received with *"support is similar every time"* (33.1%) and *"received no staff support"* (21.0%), while 10.0% consider *"staff support was better* this time" against 1.3% who *considered "staff support was worse this time"*.

Table 5. 18. Support from staff and the facilitators

Thinking about your experience on other open online courses (or MOOCs), which of these statements about the support from staff on this course best applies to you?	**%Total**	**% N-D**	**% D**	**P X-2**
Staff support was better this time	9.0%	8.9%	10.0%	0.5
Staff support was worse this time	1.6%	1.6%	1.3%	0.3
Staff support was similar every time	31.6%	31.3%	33.1%	0.4
I have studied several courses like this, and staff support is usually better than it was in this course	2.5%	2.4%	3.6%	3
I have studied several courses like this, and staff support is usually worse than it was in this course	1.0%	.9%	1.1%	0.2
I received no staff support	20.2%	20.0%	21.0%	0.1
I have never studied an open online course or MOOC before	34.2%	34.8%	29.9%	6.4
Total	**5,073**	**4,460**	**613**	
This course had Facilitators to help learners	**%Total**	**% N-D**	**% D**	**P X-2**
The Facilitators were very active on the course	26.1%	25.9%	27.5%	1.1
I did not notice the Facilitators	35.2%	35.4%	33.9%	0.2
The Facilitators responded to posts	37.4%	37.3%	38.0%	0.3
The Facilitators confused me	.4%	.3%	.9%	5.2
The Facilitators removed inappropriate posts	3.3%	3.2%	3.8%	0.9
Facilitators were not there when they were needed	1.8%	1.7%	3.1%	6.5
The Facilitators posted helpful messages	35.2%	34.9%	37.1%	1.7
The Facilitators should have done more	6.5%	6.4%	7.2%	0.8
The Facilitators provided useful links	23.9%	24.0%	23.3%	0.04
The Facilitators shared information about Open University courses	11.8%	11.4%	14.4%	5.6
I was very satisfied with the Facilitators	22.4%	21.5%	28.7%	18.4*
The Facilitators were satisfactory	18.5%	18.6%	17.5%	0.2
The Facilitators were not good	1.1%	1.0%	2.3%*	9.2
It would have been useful to have support from previous students	2.1%	1.9%	3.1%	3.3
Total	**5,279**	**4,627**	**652**	

When discussing the feedback and help provided by facilitators, disabled learners thought facilitators *"responded to posts"* (38.0%) and *"posted helpful messages"* (37.1%), *"were very active on the course"* (27.5%) and *"provided useful links"* (23.3%), while a high percentage indicated of the learners "*did not notice the facilitators"* (33.9%). There was significance in extreme evaluations when answering learners were *"very satisfied with the facilitators"* (28.7%*) or *"facilitators were not good"* (2.3%*). **Table 5.19** shows the overall experience, in general, was *"excellent"* (51.5%) and *"good"* (36.9%).

Table 5. 19. Overall experience rating

How would you rate your overall experience on this FL course?	**%Total**	**% N-D**	**% D**	**P X-2**
Excellent	48.8%	48.4%	51.5%	1.8
Good	40.9%	41.5%	36.9%	5.5
OK	8.4%	8.3%	8.8%	0.2
Poor	1.5%	1.4%	2.4%	3.5
Very poor	.4%	.4%	.4%	0.42
Total	**5,580**	**4,902**	**678**	

Table 5.20 shows figures being similar for the non-disabled and disabled learners. Disabled were more likely to *"take another free course in the subject area studied"* (11.9% v 68.6%), *"study more free materials"* (18.2% v 67.8%) and *"research the subject further"* (24.4% v 61.1%). They were less likely to *"take a paid course"* (52.3% v 34.2%).

Table 5. 20. Future actions after the MOOC

As a result of using this course, are you more or less likely to do the following?	Less likely				More likely			
	%T	% N-D	% D	P X-2	%T	% N-D	% D	P X-2
Take another free course in this subject area	11.3%	11.2%	11.9%	0.5	67.2%	67.0%	68.6%	0.5
Take a paid-for course in this subject area	42.0%	40.6%	52.3%	5.4	37.9%	38.4%	34.2%	5.1
Research this subject further	25.5%	25.6%	24.4%	0.1	58.2%	57.8%	61.1%	1
Take part in other online activities, e.g. blogging, using forums	38.3%	37.6%	43.2%	1.3	34.9%	34.7%	36.3%	0.2
Look at other related materials, e.g. books, online articles, blogs	16.9%	16.0%	23.3%	4.9	57.4%	57.2%	58.5%	0.01
Visit related museums, exhibitions, galleries, etc.	16.0%	15.0%	23.3%	6.7*	45.8%	45.9%	45.2%	0.4
Meet with other interested people offline	37.7%	37.9%	36.4%	0.1	19.1%	19.0%	20.3%	0.3
Study more free Open University materials	16.1%	15.8%	18.2%	0.5	64.0%	63.4%	67.8%	2.2
Make use of Open University materials for teaching	25.9%	24.4%	36.4%	8.8*	42.4%	42.8%	39.7%	3
Recommend Open University materials to others	13.3%	13.0%	15.3%	0.6	64.0%	63.6%	67.0%	1.1
Total	**1,448**	**1,272**	**176**		**5,174**	**4,552**	**622**	

5.8 Discussion

In this discussion, the findings of the previous section are reviewed across the topics covered in the online surveys to provide initial indicators to answers to the research questions. In this discussion statements are drawn from the survey data, these would need further validation before being applied to the general population in line with the limitations from the sampling and analysis (**Sections 5.5 and 5.6**).

- **Demographic information.** As shown in the Literature Review (**Section 2.5**) there is low understanding of who is participating in MOOCs; a better understanding of disabled learners' participation in MOOCs is the first step to research their motivations (**RQ2**)**.**

  The proportions of disabled learners taking part in MOOCs and responding to these surveys are lower than the disabled population in general, and also below current proportions found in OU registered students and in users of the OER repository OpenLearn. The sample shows greater proportional presence of female learners, those over 45 years (particularly in the interval 56-65), native English speakers and residence in the UK, for disabled learners. The total number of disabilities declared by learners reflects the fact disabled learners often declare more than one disability. Comparing this data with percentages from OU, it is showing similar proportions for highly represented disabilities such as fatigue or pain, restricted mobility and unseen disabilities.

Disabled learners are more likely to indicate with no formal or a school-leaving qualification or college diploma, data show similar proportions for disabled and non-disabled undergraduate learners. This reinforces the argument MOOCs are being taken by qualified learners (Christensen et al., 2013), though also supports the claim about MOOCs as being a useful tool to provide access to HE for disabled learners for those in the lower levels of qualification.

There is a higher proportion of disabled learners reporting unwaged with domestic responsibilities and retired, compared to full-time employment proportions. This can be related to the higher proportion of older disabled learners, while the employment difference also reflects the unemployment pattern in society (Powell, 2018), and indicates a potential gap for MOOCs in CPD.

- **Location.** Disabled learners predominantly take MOOCs at home, which implies they like to work with their own devices. This aspect is relevant to MOOC accessible design (**RQ3**)

- **Areas of interest and previous experience.** Interest in studying MOOCs (**RQ2**) is usually linked to the personal interest of disabled learners, however they are also more likely to be studying MOOCs to find out if they can study at that level and prepare themselves for future study. These interests may be related to the use of MOOCs to access HE, and the fact two other significant interests were that the course as free and to try online learning. Disabled learners also have more experience taking online courses for university credit and the use of OER while less for continuing professional development, reinforcing the previous argument.

  Participation with other online course providers and the experience using OER disabled learners are using OpenLearn in a higher proportion and MOOC providers such as edX and Coursera in a lower proportion. While these differences are not significant, it may be related to the fact these MOOC providers offer technical MOOCs for CPD in relation to the previous data showing employment and interest.

- **Devices.** Laptop and desktop computer are the primary devices used by disabled learners. However there is also higher reported use of tablets when compared to their non-disabled peers, this may be for the facilities touch-screen devices can offer to those with restricted mobility or autism (Holt & Yuill, 2017), a factor that may need to be considered for designing accessible MOOCs (**RQ3**).

- **Previous knowledge and motivation.** Disabled learners typically report some experience in the subjects they selected when choosing a MOOC, however there is a relatively high proportion who have no experience in the subject before joining. In line with the identified differences between employment status, data show a higher proportion of disabled learners with experience at school level qualification while non-disabled learners have a higher proportion with working experience. Disabled learners are particularly highly motivated when participating in MOOCs (**RQ2**).

- **Completion.** Disabled learners work through some sections of the MOOC in detail showing they were directed for their interest but did not actively participate. Not having enough time did not seem to be a reason for lower participation in the sample, the reasons disabled learners report were MOOCs being simple, that may be because FL MOOCs are designed as introductory courses to specific subjects, rather than specialised or technical (Ferguson & Sharples, 2014) (**RQ2**).

  Disabled learners did not keep up as the course progressed, which can be because of a loss of engagement, suffering from ill-health and not having enough staff support (**RQ3**).

- **MOOC design.** Disabled learners mostly considered the time required to participate in the MOOC was about right, though quite a few considered it too little, which does not seem to be related with the previous statement in completion. The structure of the MOOC was seen as very clear, finding the online discussions encouraging, interesting, helpful and thought-provoking, the tasks they did during the MOOC were thought-provoking, stimulating, important and challenging (**RQ3**).

- **Learning experience.** Disabled learners appear to like reading articles, watching videos, doing quizzes and tests or following links to other related content while they did not like reading comments and discussing things online with other learners, which may mean disabled learners are not feeling comfortable in collaborative assignments and prefer doing tasks where they can self-regulate their time and pace.

  Disabled learners enjoyed studying and would recommend the MOOC to others but found the feedback was not helpful. Their expectations were fulfilled, learning new things, supplementing existing studies and preparing for further ones, though again did not enjoy interacting with other learners. For a range of disabled learners this was their first experience in a MOOC, if not they learned about the same or more amount this time. These aspects are both related to their motivations (**RQ2**) and possible accessibility barriers (**RQ3**).

- **Course Team.** Disabled learners believe the support received was similar in the MOOCs they have already participated in or that they received no staff support. Facilitators work was satisfactory, and feedback was appropriate where facilitators responded and posted helpful messages in the forums and being active in the course (**RQ3**).

- **Overall evaluation and future actions.** Overall experience for disabled learners, in general, is excellent. They are keen to take another free course in the subject area, research the subject further and study more free materials but less likely to take a paid course than non-disabled learners (**RQ2** and **RQ3**).

The number of disabled learners in the surveys shows that there is a significant number of older learners and those with a limited academic background participating in MOOCs. They understand MOOCs are an opportunity to learn something new related to their current or future studies, that can improve their CPD, and consider an essential factor the low cost of MOOCs (**RQ2**). Disabled learners' data indicate that the design of the MOOCs is seen positively and in general they have a good opinion of the learning experience

and the course teams. They like participating in readings, videos and assignments but have lower interest in those that involve collaborative work with other peers (**RQ2** and **RQ3**).

5.9 Conclusions

This chapter has shown the data of the online surveys provided by the OU in FL is rich in the number of responses while recognising its limitations. The analysis has been innovative in showing descriptive demographic information of disabled learners participating in MOOCs, which as shown in the literature review was missing. This analysis has shown some initial indicators related to the motivations of disabled learners and possible accessibility barriers as described in the research findings and discussion.

However, these indicators are not enough to reach conclusions and answer the research questions on their own. Taking a mixed methods approach, the interviews with disabled learners that will be shown in the next chapter will give an in-depth view of real cases, to know in more detail the motivations (**RQ2**) and accessibility barriers that disabled learners encounter in MOOCs and consider ways to make them more accessible (**RQ3**).

6. Study B: The perspectives of disabled learners (interviews)

This chapter acts with the previous chapter to describe study B conducted with MOOC disabled learners. This chapter presents the perspectives of disabled learners gathered through a qualitative approach using interviews.

6.1 Introduction

This chapter explains the design of the interviews including the development of the profile for the learners (**Section 6.2**), data collection (**Section 6.3**) and the data analysis comprising of the transcription process, two iterations of thematic analysis and its validation (**Section 6.4**). Following that analysis research findings are presented in **Section 6.5** while triangulation with the survey data is detailed in **Section 6.7**. Finally, the discussion and conclusions review the research questions (**Sections 6.7 and 6.8**).

6.2 Interviews study design

Interviews have been designed with two aims: to better understand the motivations of disabled learners while participating in MOOCs (**RQ2**), and to explore accessibility barriers and their improvements from real situations (**RQ3**).

6.2.1 Learners profile

As explained in the previous chapter, in **Section 5.4**, learners across 14 MOOCs responded to the same pre, and post-course surveys, and those completing these surveys were asked to self-identify themselves as disabled.

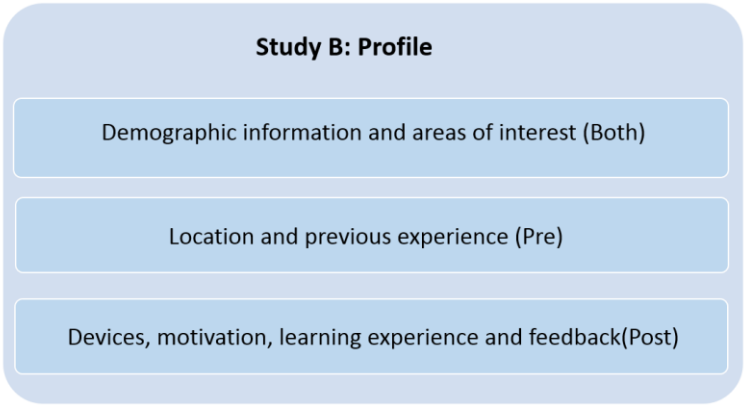

Figure 6. 1. Study B learner profile

Topics covered helped to design a profile with basic information to simplify the interviewing process and to design the questionnaire for those learners who were approached for interviews. The profile included three main areas (**Figure 6.1**):

- **Demographic information and areas of interest**. General information gathered from both surveys including the topics *"Demographic information"* (gender, age, country, language, educational qualification, employment status and disability) and *"Areas of interest"* (subject areas).

- **Areas of interest and previous experience**. Information from the pre-course survey about the *"Location"* and *"previous experience"* topics.

- **Devices, motivation, learning experience and feedback.** Data covering information related to *"devices"*, *"previous knowledge and motivation"*, *"completion"*, *"MOOC design"*, *"learning experience"*, *"course team"* and *"overall evaluation*" and *"future actions"* topics from the post-course survey.

6.2.2 Design of the interviews

For the design of the interviewing process, a Person-Centred Planning (PCP) approach has been used, with the inclusion of epistolary interviews (Debenham, 2007). This learner-centred approach allows learners to choose their preferred way to communicate (Wilson et al., 2016). For that reason, three steps where designed (**Figure 6.2**) (**Section 6.3.1**):

- **Profile.** Learners' responses from the surveys were collected to help the researcher to profile the learner to prepare the following steps. This data was collected before contacting the learners.

- **Pre-questionnaire**. Learners were contacted and once had acknowledged being interviewed two steps were followed: an online questionnaire and a semi-structured interview. The pre-questionnaire was the procedure to collect all the information missing from the profile and convenient to take the interview in the shortest time possible, allowing learners to avoid a long and stressful interview. The pre-questionnaire was using an online survey.

- **Interview.** The formal interview with learners. The pre-questionnaire included a consent form and allowed the learners to indicate if the interview would be carried out via an online survey or a Skype interview.

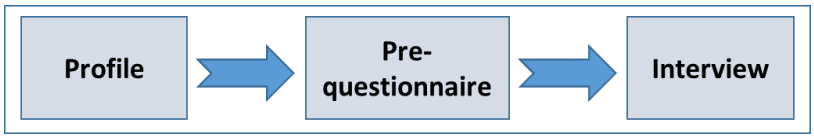

Figure 6. 2. Interview process design

The pre-questionnaire had the following structure:

1 **General questions**. (**RQ2**). Questions related to MOOC experience and motivations, to help provide any missing information from the profile built with information from the surveys.

2 **Accessibility barriers.** (**RQ3**). Attempt to identify accessibility barriers where learners had issues to allow further discussions during the interview.

Therefore, for the semi-structured interview, the researcher had information to build a set of questions based on the research questions. The interview protocols were trialled with five researchers to clarify the

order and complexity of the questions (Castillo-Montoya, 2016). The semi-structured interviews were designed to be focused on three main themes over about 30 minutes:

1 **Accessibility and daily work: current state and improvements**. (**RQ3**). Around 15 minutes. Based on the answers of the pre-questionnaire, the theme discusses accessibility barriers and how learners reacted to them.

2 **Learners' motivations when participating in MOOCs**. (**RQ2**). Around 10 minutes. The questions in the theme are developed taking into account the responses to the pre-questionnaire to understand the motivations disabled learners have while participating in MOOCs.

3 **MOOCs and adaptation**. (**RQ3b**). Around 5 minutes. The theme supports discussion of the way learners would like to have accessibility information provided in MOOCs and how they would like the content and platform to be adapted to their preferences.

The letter to contact learners, project summary sheet, consent form, pre-interview template and interview template can be seen in **Appendices 1, 2 and 5 to 8**.

6.3 Data collection

This section details the participant recruitment and the sample for the study.

6.3.1 Participant recruitment

For participant recruitment, it was preferred to identify them from the most recent data. Therefore the focus was on the survey respondents who participated in the MOOCs during 2015, and from a survey data sample with 8 MOOCs: *"The Science of Nutrition"*, *"The Science of Nuclear Energy", "Learn to code for data analysis"*, *"Smart Cities"*, *"The Business of film"*, *"The Lottery of Birth"*, *"Understanding Musical Scores"* and *"Get Started with Online learning"*. Checks were carried out to know if there was any dataset of learners already contacted from those MOOCs within OU researchers. There was no known previous research, therefore the risk of reusing already sampled learners was assumed to be low.

A set of disabled learners who had responded to the surveys and were willing to be contacted for research purposes were approached for an interview. Learners were selected from those who responded positively to the questions available in both questionnaires:

1 Do you consider yourself to have a disability?

2 The Open University, which is running this course, would like to contact a selection of survey respondents to take part in a research interview via email or telephone. The information provided will be kept confidential.

Participants were interviewed in an online environment; the interviewer provided the selected format for the interview regarding their personal preferences:

- **Pre-questionnaire.** Data for written communications were collected using an asynchronous online tool *"Online Surveys"* [63] (OS) used in the OU. This surveying system allowed the researcher to deliver an individualised pre-interview questionnaire to each learner, as well as the project information sheet and the consent form. The accessibility of OS was tested and considered as accessible by the OU.

- **Interview.** Respondents decided if they preferred to use a synchronous tool (Skype or telephone) being audio recorded (with Audacity and Cogi) or a written interview via OS. During a Skype interview, to avoid any stress, the conversation could be stopped at any time. If the option was for a written interview the researcher could contact the learner, after collection of the responses, via email to clarify any answer and provide further questions.

As Neuman & Robson (1991) proposes an approach providing communications with clear instructions and follow up reminders was used (**Figure 6.3**):

1 **Invitation letter.** Learners were sent an invitation to participate accompanied by the project summary.

2 **Pre-questionnaire.** If learners accepted to be interviewed the consent form and the pre-questionnaire were sent using OS. In this pre-questionnaire learners decided how to carry out the semi-structured interview.

3 **Interview.** Interview was arranged, and the process was closed acknowledging learners participation.

Follow up reminders were sent between the steps in cases where there was no response.

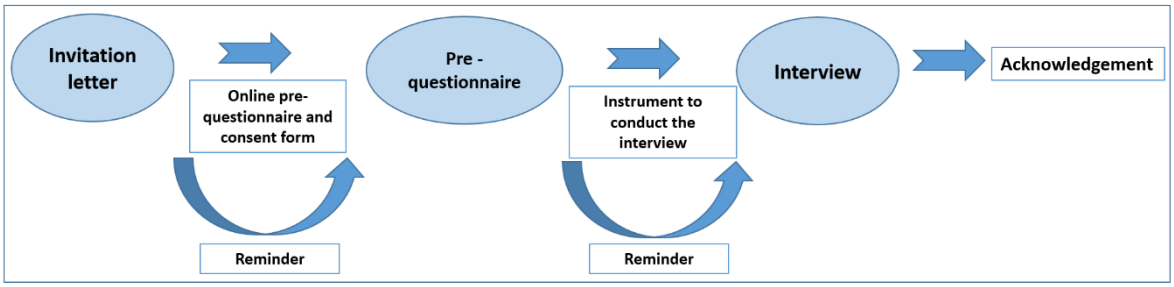

Figure 6. 3. Recruitment process

As previously explained, pre- and post-surveys' respondents were not connected. The way to link the respondents was to find a primary key that could connect them; the only option was to use the email address provided for contact. A joint group of 56 pre and post-common leaners resulted. While selecting the learners to contact, those who declared only *"other disabilities"* and *"prefer not to say"* were discarded. The three criteria to get a diverse sample are aligned with the study design (**Section 5.3**):

1 **Disabilities.** Cover a range of different disabilities in the sample.

[63] Online surveys, https://www.onlinesurveys.ac.uk/

2 **Demographical background.** Include in the sample different ranges of age, educational qualification and employment status.

3 **Previous experience**. It is essential for identifying accessibility barriers to capture different experiences with other providers than FL.

For the recruitment, a cluster sampling approach was used (Sapsford & Jupp, 2006), incrementing the sample in two different phases. As **Table 6.1** shows from the original 56 who participated in both surveys, 31 were contacted following the previous criteria, having 10 favourable responses from which 8 completed the process. These 8 interviews formed the first phase. From these interviews and their transcription, the researcher had an indication of the missing experiences and voices. For example, the sample was overrepresented by learners over 56 years and those retired or disabled and not able to work.

Table 6. 1. Participant recruitment

Surveys	Total	Contacted	Acknowledged	Finished
Pre and post- course	56	31	10	14.3% (8)
Only Pre-course	690	142	9	0.7% (5)
Only Post-course	56	14	3	3.6% (2)
Total	**802**	**187**	**22**	**1.8% (15)**

For the second phase from the remaining 690 who only answered the pre-course survey 142 (meeting the criteria to cover the missing voices) were contacted, having 9 favourable responses from which 5 completed the process. From the 56 learners who only answered the post-course survey, 14 were contacted, with 3 positive responses, 2 of them completed the interview. Considering the information that was gathered and the complexity of finding new participants the sample was closed with 15 learners, the analysis (**Section 6.4**) and triangulation (**Section 6.6**) allowed a check on whether the interviews provided sufficient data. The process took from May until September 2017.

6.3.2 Sample

Names and identifying information were made anonymous by applying a numeric code to each participant (FL + number) for all those who replied the invitation letter and a random pseudonym (for those who finished the process). To understand the demographics and general aspects of the sample, **Tables 6.3, 6.4 and 6.5** show the sample disaggregated. **Table 6.2** shows the sample disaggregated by disabilities; the table shows the percentages within the sample, where 10 learners reported more than a disability. Unseen disabilities represent the higher percentage (24.1%/46.2%), followed by restricted manual skills and fatigue or pain (13.8%/26.4%), these three disabilities are consistent with the survey data disclosed in the previous chapter, where they were also the most represented (**Section 5.7.1**).

Table 6. 2. Sample disaggregated on disabilities

	Partially sighted	Hard of hearing	Restricted mobility	Restricted manual skills	Learning difficulties	Personal Care Support	Mental health	Fatigue or pain	Unseen disabilities
Alexia FL15									
Celia FL21									
David FL18									
Deborah FL6									
Gemma FL13									
Jodie FL16									
Laura FL17									
Lorraine FL8									
Martha FL5									
Matthew FL4									
Natalie FL9									
Rebecca FL20									
Simon FL10									
Sylvia FL1									
Veronica FL7									
Total (15-29)	**6.9% 13.2% (2)**	**6.9% 13.2% (2)**	**10.3% 19.8% (3)**	**13.8% 26.4% (4)**	**10.3% 19.8% (3)**	**3.4% 6.6% (1)**	**10.3% 19.8% (3)**	**13.8% 26.4% (4)**	**24.1% 46.2% (7)**

Regarding the two other variables used for recruitment **Table 6.3** shows "*school-leaving qualification"*, *"postgraduates"* and *"undergraduates"* (26.6% each) are the most represented (**Table 6.4**). 5 learners are *"full-time employed"* while 4 are *"disabled and not able to work"* and 3 are *"retired"*. The largest group in age are those between 36 and 45 (46.6%). After FL, Coursera is the MOOC platform most used, by 6 learners. The experience participating in MOOCs has been mapped in the following way: less than 5 MOOCs as low, between 5 and 10 as a medium, more than as 10 high. The sample is balanced between 6 with low experience and 6 with high.

Other variables that have not been primary for the recruitment process show the difficulty of keeping a balanced sample when prioritising some variables over others. The sample is biased towards 80% female and the predominance of British citizens (80%) and use of English as a mother tongue (93.3%).

Table 6. 3. Sample disaggregated by age, education, employment, experience and gender

	Age	Educational qualification	Employment status	MOOC platform experience	MOOCs Experience	Gender
Alexia FL15	36-45	Postgraduate	Full-time employed	FL, Coursera, edX, Others	Medium	Female
Celia FL21	36-45	College diploma	Full-time employed	FL, Coursera	Low	Female
David FL18	36-45	School-leaving qualification	Full-time employed	FL	Low	Male

	Age	Educational qualification	Employment status	MOOC platform experience	MOOCs Experience	Gender
Deborah FL6	56-65	School-leaving qualification	Full-time carer for severely disabled familiar	FL	High	Female
Gemma FL13	36-45	Postgraduate	Disabled and not able to work	FL, Coursera, Stanford Online, edX, NovoEd, Canvas, Open2Study	High	Female
Jodie FL16	36-45	Postgraduate	Unwaged and seeking employment	FL	Low	Female
Laura FL17	36-45	School-leaving qualification	Full-time employed	FL	High	Female
Lorraine FL8	46-55	Postgraduate	Disabled and not able to work	FL	High	Female
Martha FL5	56-65	Undergraduate	Disabled and not able to work	FL, Others	High	Female
Matthew FL4	36-45	School-leaving qualification	Unwaged and seeking employment	FL, Coursera, edX, Open2Study	High	Male
Natalie FL9	56-65	Undergraduate	Disabled and not able to work	FL, Coursera, Udemy, Others	Medium	Female
Rebecca FL20	26-35	Undergraduate	Full-time employed	FL, Others	Low	Female
Simon FL10	65 +	No formal qualification	Retired	FL, Coursera	Low	Male
Sylvia FL1	65 +	No formal qualification	Retired	FL	Low	Female
Veronica FL7	65 +	Undergraduate	Retired	FL	Medium	Female

Only one learner reports using assistive technologies to access MOOCs, while most make use of a desktop computer and access the MOOCs from home. The preference to participate in the interview was text-based (60%) (**Table 6.4**).

Table 6. 4. Sample disaggregated by country, AT, device, location and interview type

	Country Language	AT	Main Device Location	MOOC	Survey	Interview
Alexia FL15	France ESL	No	At home	Smart Cities	Pre	Text-based
Celia FL21	UK English	No	Laptop At home	The Lottery of Birth	Pre	Text-based
David FL18	UK English	No	At home	The Business of Film	Pre	Text-based
Deborah FL6	UK English	No	Desktop At home	Get Started with online learning	Both	Text-based
Gemma FL13	UK English	No	Desktop At home	Understanding Musical Scores	Pre	Text-based
Jodie FL16	UK English	No	At home	Get Started with online learning	Pre	Audio
Laura FL17	UK English	No	Tablet	Understanding Musical Scores	Post	Text-based
Lorraine FL8	UK English	No	Desktop At home	Learn to code for data analysis	Both	Text-based
Martha FL5	USA English	No	Tablet At home	Elements of Renewable Energy	Both	Audio
Matthew FL4	UK English	No	Laptop At home	Get Started with online learning	Both	Audio
Natalie FL9	UK	No	Desktop	The Science of Nutrition	Both	Audio

	Country Language	AT	Main Device Location	MOOC	Survey	Interview
	English		At home			
Rebecca FL20	UK English	No	Desktop	The Business of Film	Post	Text-based
Simon FL10	Australia English	No	Desktop At home	Understanding Musical Scores	Both	Audio
Sylvia FL1	UK English	No	Desktop At home	Get Started with online learning	Both	Text-based
Veronica FL7	UK English	large print, large black cursor	Desktop At home	The Science of Nutrition	Both	Audio

The sample of 15 learners is heterogeneous thanks to the recruitment criteria but limited to consider wider disability groups and diversity in society. The selection criteria have produced the over-representation of other sampling variables. Learners have been selected prioritising the participation in several MOOC platforms and answering both surveys, to have rich data prior to the interview, as set in the study design (**Section 5.3**). The implication is greater representation of successful and experienced MOOC learners and perhaps missing the voices of those who dropped out at the early stages of MOOCs participation and were less experienced using MOOCs. Limitations are expanded on and discussed further in **Section 9.5**.

6.4 Data analysis

This section presents how the transcripts have been produced and analysed using thematic analysis.

6.4.1 Transcription process

Following a similar approach to study A (**Section 4.5.1**), complete transcripts from the verbal data have been produced, transcribed by the researcher from the interviews that were taken with recorded audio. An intelligent verbatim transcription approach has been used followed by an edited transcription to provide the quotes used in the text written in British English for readability and consistency

In this study part of the interviews were epistolary and taken in a written format, possible typos were corrected following the same approach. One learner used ESL, one American English and one Australian English, however, the challenges associated with foreign language transcription were minimal (MacLean et al., 2004).

6.4.2 Analysis process

Analysis followed the 6-phase of thematic analysis, shown in **Table 6.5**, by Braun & Clarke (2006) (**Section 3.4)**. Printed copies of the transcripts and NVIVO software were used to support the analysis. Each iteration has been developed from the previous analysis; in this case, the process had three levels of depth for the themes, representing an interpretative level approach.

Table 6. 5. Thematic analysis in study B

Phase	Iterations
1. Familiarising with the data	1

Phase	Iterations
2. Generating initial codes	2
3. Searching for themes	2
4. Reviewing themes	2
5. Defining and naming themes	2
6. Producing the report	1

The two iterations detailed are:

- **The first iteration.** All 15 interviews were analysed from the beginning. Themes and sub-themes have been obtained using an inductive perspective to understand the richness of the information provided by the learners. These themes have been structured over the two pre-established deduced main themes related to the research questions, this deductive approach helps reasoning from the particular to the general using the research questions (Hyde, 2000):

    - "*Learners motivations"* while participating in MOOCs (**RQ2**)

    - *"Accessibility in MOOCs"* (**RQ3**) with three themes *"Accessibility barriers and enablers"* (**RQ3a**), *"Response to accessibility barriers"* (**RQ3b**) and *"Solutions proposed to accessibility barriers"* (**RQ3b**).

  The analysis generated 39 sub-themes. The strength of this iteration is in knowing the different topics covered in the interviews, however its inductive approach produced an unmanageable number of sub-themes. In this phase of analysis the need to include more interviewees was not detected, and it demonstrated that a broad group of situations with the interviewees was available to address the research questions.

- **The final Iteration.** The final iteration was based on the previous one. An intensive exercise to reduce the sub-themes from the first iteration was driven by the research questions. Reflecting the high number of codes and the three levels of depth created, in this iteration three structural themes to enrich the analysis were created: "*Disability"*, *"MOOC Structure"* and *"Origin"*. For consistency in the nomenclature, MOOC structure is as specified in the literature review in **Section 2.5** (e.g. "Platform design and access", "MOOC design", "Educational resources", "Discussion, assignments, test and quizzes" and "Help: report and feedback"). The result is 4 sub-themes for the *"Learners motivations"* and 9 sub-themes for the *"Accessibility in MOOCs"*.

The thematic map from the first iteration is shown in **Appendix 9.**

6.4.3 Analysis validation

An inter-reliability process was followed with one the supervisors acting to validate the semantics of the final iteration. The supervisor was provided with 94 quotes (11.45% of the data set) and 3 possible answers randomised across the sub-themes, the agreement was substantial with a Cohen's Kappa of 0.79 (**Table 6.6**).

Table 6. 6. Cohens Kappa for the final iteration validation

	Value
Relative observed agreement	80/94
Hypothetical probability	1/3
Cohens Kappa	0.79

6.5 Research findings

The final thematic map can be seen in **Figure 6.4**. Main themes and sub-themes are defined and explained further in this section with the use of representative quotes.

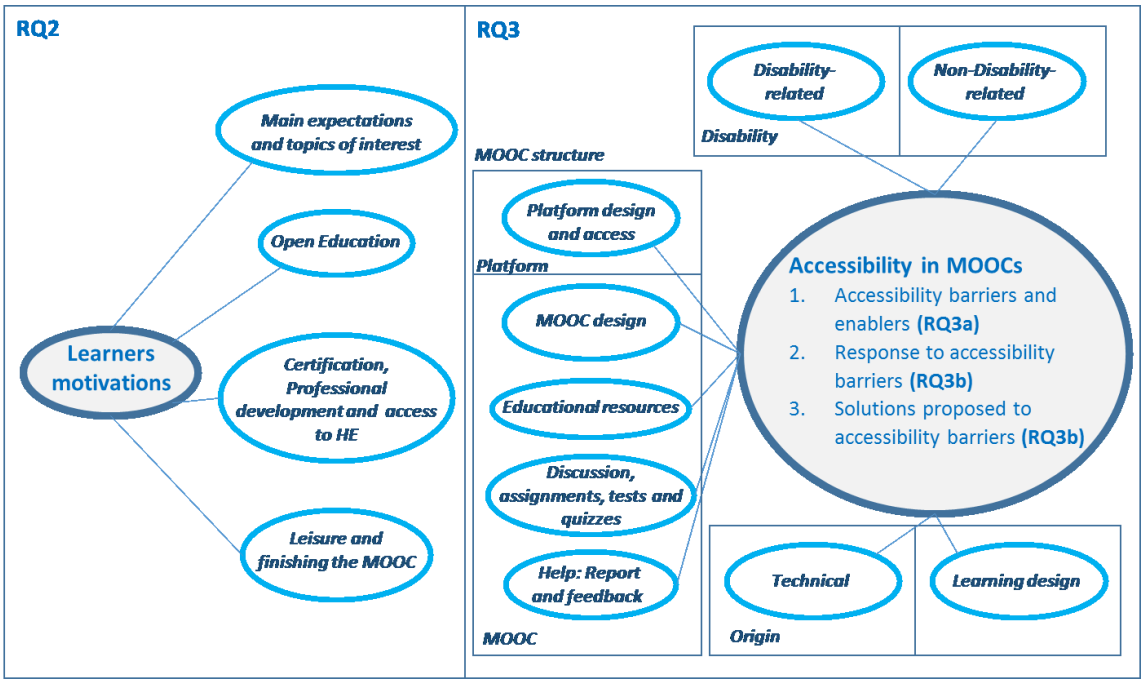

Figure 6. 4. Thematic map representing the themes and sub-themes at the final iteration

The quotes are attributed to the authors following a structure which refers to the sampling criteria:

(Name, Disabilities, Age, Highest educational qualification, Employment status)

Acronyms used for disabilities are: partially sighted (PS), hard of hearing (HH), restricted mobility (RM), restricted manual skills (RMS), learning difficulties (LD), personal care support (PCS), mental health difficulties (MHD), fatigue or pain (FP) and unseen disabilities (UD).

6.5.1 Learners motivations

Learners' motivations (RQ2). The motivations of disabled learners while participating in MOOCs.

- **Main expectations and topics of interest**. General impressions while participating in MOOCs.

Learners' answers on being asked about their motivations to participate in MOOCs showed every learner is different and that expectations depend on their previous learning experience. Learners indicated a general commitment where the main interest is the MOOC subject, where they can learn from a broad number of subjects at their own pace (not committed to a timetable), and in an entertaining and friendly environment compared to those face to face. The low cost of MOOCs offers the facility to invest more effort in learning

or exploring to get a basic understanding of the topic (i.e. using MOOCs as a taster), therefore MOOCs offer learners the chance to challenge themselves with new educational stimulations.

> *I was interested, as my job at the time was very mundane and unchallenging. I felt I was missing out on learning about new and interesting topics. I felt unchallenged and wanted to challenge myself and use my brain more to better myself and absorb more knowledge (…).* ***I gained an interest in MOOCs and how many different platforms and subjects you can access them from*** *(…).* ***They give time for your brain to be stimulated and give you the opportunity to challenge yourself****. I think everyone should be able to educate themselves about topics that interest them. It influenced me to participate in them as money was no longer an excuse.* Rebecca, LD, 26-35, undergraduate, full-time employed

For some disabled learners participating in MOOCs was their first experience with online learning, with MOOCs acting to provide the link between attending regular classes and study from their homes. Motivations for using MOOCs can be related to their disabilities, and to their situation. In general, those interviewed showed that MOOCs are playing a role in their personal development and the experience exceeds their expectations.

> *I think they are magic I think they are wonderful; the whole thing is just amazing because I am old enough to remember when in the local public library did not have a book in something you could not learn about it.* ***So this whole business of being able just to go and contact experts is fantastic and the fact that is free it is even better because one of the consequences of my illness is that I cannot work****. I might be sitting here with the time to do it and not with the funds if I had to pay it so yeah I think it's brilliant the whole thing is brilliant*. Natalie, MH, FP, 56-65, undergraduate, not able to work

- **Open Education**. Access to free and open education.

Aligned with previous observations, access to free MOOCs and open education adds value. Some learners interviewed were in a low-income situation, reinforcing the argument everyone should have the opportunity to access high-quality educational resources to inspire future learning and personal development.

> *I am on a low income (benefits) because of my health issues, and* ***I do not have much money available so free courses are wonderful. Also, with the fact I often can't finish a course on time or have to leave it, paid courses are too much of a risk financially****. I have yet to pay for an online course, though I do have a couple bookmarked for the future if my health allows me to be more energetic.* Gemma, PCS, FP, UD, 36-45, postgraduate, not able to work

This appreciation goes against some of the business decisions applied by some of the MOOC providers (including FL) in closing free access to the MOOC two weeks after it is finished. Some learners pointed out the fact of MOOCs being free allows trying them out and leaves learners with the decision to continue if they are interested in the subject. It was raised in the interviews the inconveniences of the upgrade system introduced by FL that means having to pay to get access. Resulting in learners having to select and refine for only those subjects learners want to do or require the concessions for those on a low income.

> *Some people have had a very bad experience in school, the way to get them interested in learning again is to provide free courses.* ***The free courses on the MOOCs are, you could say adverts for the longer courses,*** *so what you do is,* ***you provide free MOOCs at the lowest end of the level, but it gets people interested, if they can take a free course it is a scattergun approach to learning****. Allows them to refine what their interests are going to be. (…).* ***If I am going to have to start paying for my courses*** *what I cannot afford,* ***that is going to put me off of going for those courses that may be***

good, may be interesting to me and may further refine the sort of work I would like to go. Matthew, MH, 36-45, school-leaving qualification, unwaged

- **Certification, Professional development and access to HE**. Supplement degree study and better professional development.

Some learners appreciated MOOCs can be useful for CPD, acquiring knowledge and getting a certification to add into their CV (Curriculum Vitae). They recognised that this could demonstrate to an employer an ability and interest in education, and it shows learners are capable of finding and completing training by themselves.

> ***It gives you a sense of achievement, and you are able to show employers that you are trying to better yourself.*** *I am currently about to do a master in Film and TV Producing and during my interview I was asked about my Social Media Marketing course via a MOOC, and I said I wanted to adapt the course to see how it would benefit TV & Film producing.* ***It showed my tutor that I wanted to better myself and was willing to see how certain skills could strengthen others***. Rebecca, LD, 26-35, undergraduate, full-time employed

Not all learners saw certificates as being useful since they do not consider MOOCs are comprehensive enough to count for certification, though still consider they can be used for CPD. Certification is linked to their motivation and gives learners confidence in finalisation and achievement. Some learners acknowledged certificates should provide rich information on the learning achieved to obtain the certificate, in this way certificates should offer useful information such as learners' performance in the MOOC.

> *At the end of it (Open2Study)* ***you actually get a free certificate, it may not confer any genuine academic qualification, but it does show, one that you've done the course****, how well you did in the course. Because one thing where FutureLearn falls down is with their certificate of participation that they used to sell, all we had to do with fifty per cent of the course it didn't confer any qualifications to you, but it also didn't say how well you did (….).* ***Even if it does not give you credit for university course you could say I have done this MOOC here is my certificate, it is a free one, but these are my test results on that MOOC.*** Matthew, MH, 36-45, school-leaving qualification, unwaged

Learners considered certificate prices should be proportional to the MOOC length, content and level of academic certification, for those professionals who are at the beginning of their career or unwaged, free certifications should be provided to encourage them to carry on. MOOCs can be useful to access HE, either as to complement to a course or as an induction to be taken before progressing to a University degree, both ideas are aligned with CPD.

> *I did learn some things yeah because obviously,* ***I did it before I actually started properly on my law course*** *(at the OU), I actually learned quite a lot which is why I saved some of the links on my favourites bar (…).* ***I think employers would look at them, I know it is not a qualification, but it is a certificate that shows that you have that skill and that you have completed certain tasks and achieving certain skills*** *(…). I even think* ***people who have unemployment maybe they should be part of their professional development*****.** Jodie, RM, RMS, MH, 36-45, college diploma or certificate, unwaged

- **Leisure and finishing the MOOC.** Occupy the mind and compromise finishing the MOOC.

Some learners reported they take MOOCs for leisure, to keep their mind active, without any other motivation than their enjoyment.

> ***I needed a mental outlet and something I could do at home.*** *The FutureLearn was just* ***what I needed, short, challenging, a huge variety of courses and the chance to choose topics*** *I would not have been able to do in school and free which was a big factor.* Deborah, HH, 56-65, school-leaving qualification, full-time carer

In general, learners interviewed have a general commitment to trying to finish the MOOCs if possible. Interest in the subject is a vital factor.

> *I have finished most of them, not even done any for a little while, I did not have the time, but I will be back doing them again soon.* ***If I start something, I always want to finish it, there was a course I did not finish, I had some troubles, and I could not finish it on time, but I will eventually take that course again.*** Simon, RM, RMS, UD, 65+, no formal qualification, retired

6.5.2 Accessibility in MOOCs

Accessibility in MOOCs (RQ3). The current state of accessibility in MOOCs and help to identify and solve accessibility barriers.

The three themes depending on this main theme are:

- **Accessibility barriers and enablers (RQ3a).** The barriers found by learners while participating in MOOCs.
- **Response to accessibility barriers (RQ3b).** The responses of learners to those identified barriers.
- **Solutions proposed to accessibility barriers (RQ3b).** The solutions learners would like for the identified barriers.

The "*accessibility in MOOCs"* theme is broken down using the *"MOOC structure"* sub-theme discussing the *"barriers", "responses"* and *"solutions"*. With this approach, it is possible to show the differentiation between each of the MOOC components, and associate the responses and solutions proposed by learners to the identified barriers (**Figure 6.4**).

- **Platform design and access.** The design of the platform, the software that hosts the MOOCs and access to it.

When talking about the *"platform design and access"*, **barriers** had to do with the platform language, in particular for learners using ESL the instructions in the menus may not be clear. Different formats between platforms are not helping as learners need to get used to different designs. The *"sign in"* and *"registration"* processes are a commonly reported barrier. These barriers interacting with the platform may affect the learner' self-esteem.

> *If* ***I wanted to change my email address, then I would lose all my courses to date and records****. This should be easier to do (…). I am in my 60's so to compare my computer skills to younger people whose computer skills are part of their lives, and upbringing* ***made me feel out of my depth sometimes****.* Deborah, HH, 56-65, school-leaving qualification, full-time carer

Platform design needs to consider all kind of devices to access (e.g. from a laptop to a smartphone). Some leaners reported problems with the design, which needs to work in different types of screen sizes and resolutions. Another barrier reported is the lack of access to the courses and their educational resources when learners cannot access the internet on the move.

> *I am blind in one eye and a tunnel vision in the other,* ***I can only see a small part of the screen at one time when I am looking at one part if something happens in another part of the screen, I can miss it****. It is looking in a telescope, that is how I see, I have a 19 inches screen, but I can miss things.* Veronica, PS, HH, 65 +, undergraduate, retired

Learners' **responses** included using external tools for the translations or giving up.

> *I use it (Google translator especially). However, the translations are not very good.* Alexia, US, 36-45, postgraduate, full-time employed

Solutions included the availability of multilingual options in the platforms and a better design, which for learners meant making things as simple as possible. Learners appreciated options for profiles since they could then be recommended on which MOOC fits better with their preferences. They would like to have access to all the educational resources, including potentially downloading those all in one go to save internet and mobile data.

> ***Profiling I think is a great idea as it is tailored to you. There are also certain topics that interest me****. Such as film/TV/Creative Writing.* ***But I often find myself scrolling through so many different courses to seek out ones that would suit me. I often worry that I am missing out on courses****. I like the idea of videos being tailored to the learner's needs. It would be a very beneficial technique for me.* Rebecca, LD, 26-35, undergraduate, full-time employed

- **MOOC design.** The design of the MOOC, pedagogies involved, workload and information provided about the MOOC.

Not having enough time to finish the MOOC is a commonly reported **barrie**r. This barrier can be related to a disability, learners with fatigue or concentration problems may limit their screen time, meaning they cannot follow the course at the same speed than others leading to them falling weeks behind and with a continuous feeling of having to catch up. The lack of time can also be linked to day to day commitments, such as taking care of a family, working and being a full-time student, making it challenge to carry on MOOCs until the end.

> ***I have health problems, and there are some weeks when I could get quite a lot in another week when I cannot do very much at all.*** *What I found was in several courses is the timing hasn't worked out very well because I'll just start them and I will have a few weeks when I really can't do anything, and then* ***by the time I can get back to them, I've kind of lost interest, or I feel so far behind everybody****.* Natalie, MH, FP, 56-65, undergraduate, not able to work

It was reported learners who cannot finish on time and do not pay for an upgrade in FL lose access to the MOOC, missing the opportunity to study by their own after the MOOC is finished. Learners can re-join the course, however all the relationships they may have built up with other learners will be gone, making it difficult to go for a second run of the MOOC from the same point where they left with a new group of learners.

The MOOC design itself can be a barrier influencing engagement: the chronological order of modules, if the content and assignments per week are too few or too many or if learners feel they are only constantly clicking on the next button rather than expending time studying the educational resources.

> ***Reasons for not finishing are a poorly designed MOOC****, in which case* ***I gain frustration and a determination to research the subject myself, or for the ones that I ran out of time and energy at least, I got some of the knowledge available****, and hope to come back later to retake the MOOC.* Gemma, PCS, FP, UD, 36-45, postgraduate, not able to work

The complexity of the course is not always appropriately highlighted during MOOC enrolment and can derive in learners' dissatisfaction.

> *One course* ***I had to give up, it was just too difficult, it assumed, you needed previous knowledge which isn't good at all.*** *The MOOC has to assume that there are people without the knowledge, there were sometimes I had no idea what they were speaking about, but they had assumed I would know the meaning of the things, some of the courses you have to be taught a bit more.* Veronica, PS, HH, 65 +, undergraduate, retired

Responses to those barriers included abandoning the MOOC and waiting until eventually there is the next run of it, which can add frustration since that information is not always available. When learners do not know if the course is going to be rerun, they may still sign up for it because it is a subject they are interested in with the hope to find the time to finish it.

> ***I thought about coming back when they have the next run on some of them, but it is going to be a question of timing.*** *I started one two weeks ago, and now is on week three, I did the first week, and the next two weeks I have not been able to do them yet. It is a pain in the arse for me because never know for sure* ***a lot depends on what else is happening in my life and how much stress I am under therefore how much pain I am in****.* Natalie, MH, FP, 56-65, undergraduate, not able to work

A better self-organisation of their time to be able to study was another common response. Some learners being aware MOOCs have several runs try to spread out courses and not take too many at once, tracking on when courses are rerun to avoid them needing the same timeframe. In that sense, learners tend to leave a time slot each week to work in MOOCs (e.g. in the evening after family commitments), with the aim to avoid falling behind or needing to do a lot in the last days of the MOOC.

> ***I would try to set one evening aside each week and make sure that time was spare****. If some weeks this was not possible due to work and other commitments,* ***I would try to do half an hour first thing in the morning before work to make sure I kept on top of the work and did not fall behind****.* Rebecca, LD, 26-35, undergraduate, full-time employed

Finally, another typical response was skipping parts of the MOOCs; learners focused on the parts that were most relevant for them as another approach to fighting against deadlines and being able to finish the MOOC.

> ***If I could think of something appropriate, I did the exercise, otherwise I skipped it. After all, I am not doing these courses for credit, only for my own information*** *(…). Well I've always finished when I am going all the way through some of them,* ***I did not do the peer review because I was not that interested in the MOOC itself so just skipped that part and did everything else****, but I always finish all the way through other ways.* Martha, PS, RM, RMS, FP, UD, 56-65, undergraduate, not able to work

Some of the **solutions** proposed included adding richer information about the accessibility of the MOOC and more precise information about the time needed. Learners are asking for transparent and fair information about the previous knowledge needed, learning goals to be achieved, the workload expected, how long the content is going to be available and information about the next runs (or if there is a rolling start date), to better decide on enrolling in the MOOC and organising their time.

> ***Detailing that the platform includes transcripts, audio transcripts and other features before a person signs up would be useful.*** *Also ensuring the course provides these properly (….). For me, knowing in advance* ***how much extra time is available after the end of the course, or if the course will be available in a non-interactive way, or be re-run****, would help greatly.* Gemma, PCS, FP, UD, 36-45, postgraduate, not able to work

All MOOC content should be available from the beginning, which would allow learners to plan their time and advance work better. Some learners preferred self-paced MOOCs since they can work without time restrictions. Not removing access after the course is finished is another common solution proposed.

> ***I think it would be beneficial if all the information was available to you from the start.*** *It limits the stress of having to keep to a time scale and makes it easier to go at your own pace. I often found at times during a course that although I felt a few weeks behind everyone else, I was still able to interact with other learners via message boards and comment sections which were at a similar stage to me (…).* ***I think giving a time scale is appropriate in some sense*** *especially if the MOOC is run via video or webinar, as I feel you need to be more involved and take part. However, some MOOC do not need a timeframe, for example, I am currently doing a MOOC in Excel****. I have unlimited access to the learning material which means I can do it at any time.*** Rebecca, LD, 26-35, undergraduate, full-time employed

To improve the MOOC design learners asked for additional features to help with the engagement and to allow more interaction. MOOCs should have a balance between their length and their structure: educational resources, quizzes and assignments. Some learner identified videos as too time-consuming and learners would benefit from alternative formats such as reading articles.

> *I think with some of them like the crime and society* ***I would have liked a little bit more variation, I would have liked the course to be a little bit longer and include some more different areas of law*** *(…). I know they are meant to be short courses, but I would have liked maybe a little bit more.* Jodie, RM, RMS, MH, 36-45, college diploma or certificate, unwaged

- **Educational resources.** All the educational resources that may include articles, videos, podcasts, images, text, documents and third-party software.

While discussing the **barriers** in educational resources, the availability of subtitles and transcripts in videos were a common barrier since subtitles are vital for some learners to follow the video. In MOOCs there is a dependence on only visual content and when videos fail, the availability of transcripts is crucial, and also offer an alternative format when learners have no time to watch a video or poor internet connection.

> ***I founded once or twice that I could not get the quality of sound****, and sometimes I could not get the video in my old equipment. What I found useful was the transcripts, so* ***the transcripts cover any inadequacies in the sound quality, and it is very good to have that, even if it herded perfectly sometimes it is natural learning if you can read the materials as well****.* Veronica, PS, HH, 65 +, undergraduate, retired

The text-based files and images may need software not all learners have installed (e.g. office software in a smartphone), PDF documents may need a subscription to use them, and the resolution of the images may be too low.

> ***I do not have office software on my phone*** *so making them more accessible such as per or kindle type documents minimises the number of apps on the phone.* Laura, UD, 36-45, school-leaving qualification, full-time employed

Responses to barriers included the use of subtitles and transcripts when English is used as ESL. Not all learners liked the videos, which are frequently used in MOOCs, and found transcripts to be an alternative source to follow the course.

> ***I use the two possibilities at the same time (watching and using subtitles). By acting like this, I try to improve my written and oral comprehension*** *(…). When I am watching videos, I certainly use the translation, but I am trying the subtitles too. I always download the files attached to the video.* Alexia, US, 36-45, postgraduate, full-time employed

Some of the **solutions** proposed by learners suggest ensuring transcripts are always available and visible when the video is being played. Some learners liked to have videos instead of written materials or articles, but others liked to print the transcripts and save time reading them. The length of the videos is considered essential to keep learners engaged and motivated, and learners preferred short videos. Learners did not make distinctions if video content should include the academic standing or the use of presentations and whiteboards, they valued that videos are engaging (e.g. introducing real-life events and situations where learners can feel represented).

> ***I did like to watch the videos because I seem to take more in from a video than if I am reading something.*** *I would have liked to see more videos* ***I think I liked the fact that it was real life events*** *and I think the things I don't like is too much reading (…). I prefer the videos rather than reading and I actually think it's good that they had a video and transcript because then you know you can print the transcript off (…).* ***It depends what the content of the video was; sometimes it was not a very interesting video of just one-person speaking was too long****.* Jodie, RM, RMS, MH, 36-45, college diploma or certificate, unwaged

- **Discussion, assignments, tests and quizzes.** Forums or discussions embedded in the educational resources, P2P or individual assignments, test and quizzes.

The **barriers** found in this sub-theme include the fact that skipping parts of the MOOC such as assignments affect the interaction and participation in discussions afterwards; if learners decide not to do optional assignments, they cannot follow the discussions around those by other learners. Some learners disliked the P2P assignments because they need to be evaluated by other learners and they needed to evaluate the work of others. The lack of appropriate evaluation guidelines can affect how some learners evaluate others' work and so create uncomfortable situations.

> *I did a creative writing one that required you to have your writing critiqued by other people, and you had to critique theirs, and I found that really uncomfortable* ***I did not like critiquing other people's work but let alone them critiquing mine, I do not enjoy that sort of things, at all****.* Natalie, MH, FP, 56-65, undergraduate, not able to work

Some learners liked using forums and participate in discussions while others did not wish to participate in discussions. Even if participating in discussion forums is appreciated, some learners may feel challenged and find it increasing their anxiety, influenced both by other learners' opinions and poor design of the forums.

> ***Occasionally you run into somebody who is very argumentative and just wants to keep going on*** *and you just have to kind of cut off the conversation, you cannot always agree with everybody, but* ***that makes it all a little bit more interesting****.* Martha, PS, RM, RMS, FP, UD, 56-65, undergraduate, not able to work

Learners valued the quizzes which provide feedback but were wary of losing access or them having a timer.

> *The tests were* ***a great way to see how much I had learnt and if I got some wrong, I could go back to my notes and retake the test until I had got it right****. It was a much calmer atmosphere then taking an exam at school.* ***Although on some tests I was timed I still felt comfortable taking the test***. Rebecca, LD, 26-35, undergraduate, full-time employed

When discussing the **responses** to those barriers, some learners complained that conversations in the discussions are only about the assignments and do not help with motivation and time management. Learners agreed reading others' comments can help the learning process and socialising. Skipping assignments was one of the responses as was dropping out from the MOOC, since the P2P assignments may affect learners' anxiety.

> *I have been in courses where I do the peer to peer stuff,* ***I must admit I've always skipped those bits not because I don't think they are worthless, and this is possible because of my depression I suffer from****.* ***I don't want people to look at my stuff and tear it to shreds because I have very fragile self-esteem*** *(…) I don't really want to show my ignorance in front of another pair even though they might have exactly the same idea that I am, or I may be I may have grasped the subject better than them.* Matthew, MH, 36-45, school-leaving qualification, unwaged

MOOC providers have different approaches while designing discussions, FL allows discussion in each step while the others have a particular space in forums. Learners may take several approaches: only to post their comments, to read posts from others or to find a balance in between. Some learners found reading other learners' comments can help to consolidate their thinking, change their opinion and participate in productive discussions. In general MOOC learners preferred to get the information they need from the MOOC facilitators than from other learners since facilitators are expected to be experts on the topic.

Solutions proposed include avoiding compulsory P2P assignments or tests, only requiring them if learners want to get a certificate. Alternatively, MOOCs should provide better instructions on how to mark assignments by other peers and how to have proactive and positive feedback. It was noted that facilitators should invest time at the end of the MOOC to review the final assignments to certify learners.

> *I do not think optional, because if it is optional a lot of people would not get marked, because* ***the tutors cannot mark so many people, they have to rely on us to help them, but I think they should give us clearer directions on marking*** *(…).There is where it should be explained better what the actual requirement is. Most people were very good, giving comments on how it could have been done better, it is good to get comments like that, and you do not want somebody judging you. That is why I like it,* ***thankfully most of the people do the right thing by giving positive feedback****, there were some that wanted to be tutors instead of learners.* Simon, RM, RMS, UD, 65+, no formal qualification, retired

- **Help: Report and feedback.** Report and feedback on accessibility barriers.

When talking about the **barriers** that affect help reporting, some learners seemed to have missed the information. They were not aware of the existence of help or the role facilitators can play, learners considered discussions are only for educational feedback and not a place to ask for help. Some learners referred to their health problem as a cause of being delayed and not considered that anyone else can help with their situation. In general, the feeling was that they would only be able to get help with technical or educational aspects, but not with time management or disability-related difficulties, considering these as personal matters. Other learners were aware that there are ways to find support and contact staff. As reported previously help from facilitators and staff was preferred over asking for help from other learners.

> ***I have very rarely contacted anyone who runs the MOOCs because it is not necessarily a problem with the content it is a problem with my mental health which they cannot help with*** *(…). Sometimes that will slow me up and then I'm so far behind I do not want to stop the people in front of me to help me or by contacting the people around the MOOC and that is my choice not to.* Matthew, MH, 36-45, school-leaving qualification, unwaged

Responses to barriers included contacting staff using email or a *"do it"* request (i.e. form available in the MOOC platform). Learners found themselves getting standard, not personalised responses.

> *I emailed FutureLearn to complain about the changes to their structure and* ***got a standard reply and a link to an online discussion which had been closed to further comment****.* Gemma, PCS, FP, UD, 36-45, postgraduate, not able to work

Solutions suggested included the possibilities not to have to use the discussions to ask for help and adding a chat box to allow *"one to one"* synchronous options. Social media (e.g. Twitter) was considered helpful as a way to contact facilitators.

> *I think* ***live chat is useful, particularly as a course commences for help with any technical issues****. It would be good if learners could use it to help each other as well.* Lorraine, RMS, LD, FP, UD, 46-55, postgraduate, not able to work

Learners suggested having a better knowledge of whom to ask for help. There should be clear information on help at the beginning of the MOOC. There was a criticism of those facilitators who are not answering questions and relying on learners to do that work.

> *Some of the* ***educators they are not that much up front as they used to be, for answering specific questions from learners, sometimes leave it to other learners, you cannot always guarantee that the other learners will be getting the correct answer****, I would like to see a little bit more input for the educators, particularly in the comments.* Veronica, PS, HH, 65 +, undergraduate, retired

- **Disability: Disability-related \ Non-Disability-related.** The barrier is related to a disability; following the social model this can include personal conditions, language, cultural barriers, internet access and technology availability.

> *Because I am a mental health service user I was on a course called preparing for work and I said this would be brilliant for the people in that room,* ***people with mental problems who may need a bit of help to get into work if they can find an employer who will actually take them, but because of the***

> ***same problem I have with my mental health, they wouldn't be able to do it in the three week spot*** *that they are given, it is a three weeks course and there are so many steps and so many questions.* Matthew, MH, 36-45, school-leaving qualification, unwaged

When analysing the data, it is difficult to know in many cases if a barrier has to do with disabilities, being situations that can affect all learners. However, it does seem that those with disabilities require particular attention to the time needed to participate in MOOCs, and support for their self-esteem when doing assignments, discussions and quizzes, and are given appropriate access to the MOOC content taking into account the MOOC and platform design and multiple formats for the educational resources.

- **Origin: Technical \ learning design.** The origin of the barrier is technical or is related to the MOOC learning design.

The origin of the barrier can be related to technical barriers which in some cases have to do with the platform design or to the accessibility of the educational resources (or both); the pedagogical design of those resources may be producing barriers, for example long videos or unstructured MOOCs.

> *Often the MOOC comes to an end* ***I can't submit work or get tutor feedback but can still access the course materials in my own time.*** *If the course finishes and is then removed or becomes a paid option, I'm unable to do that.* ***Where it's just video lectures, it's too time-consuming so I can't continue.*** Gemma, PCS, FP, UD, 36-45, postgraduate, not able to work

6.6 Triangulation

Interview and survey data have been used for triangulation applying cross verification (Hammersley, 2008). Primary data are the interviews, while surveys (secondary data) have helped to generate preliminary results that in this section are compared with the findings from the interviews presented in the previous section. Recognising that there are limitations of representation from both sources, as described in **Sections 5.5 and 6.3**, this triangulation is an exercise to match the research findings and discuss the similarities and differences.

Table 6. 7. Triangulation between interview sub-themes and survey topics

Interviews sub-themes		**Survey topics for profiling**	
Main expectations and topics of interest. (1) (2) (7)	**Pre - Course**	1	Areas of interest and previous experience
Open Education. (1)			
Certification, Professional development and access to HE. (1) (3)	**Post - Course**	2	Previous knowledge and motivation
Leisure and finishing the MOOC. (3) (5)		3	Completion
MOOC design. (3) (4) (5)		4	MOOC structure and design
Educational resources. (3) (5)		5	Learning experience
Discussion, assignments, tests and quizzes. (3) (4) (5)		6	Educators and Facilitators
Help: Report and feedback. (3) (6)		7	MOOC Experience evaluation

Table 6.7 shows how the different sub-themes from the interviews have been linked with the survey topics. Sub-themes have been associated with the following questions (referenced as tables) from the previous chapter as follows:

- **Main expectations and topics of interest. (Tables 5.8, 5.10, 5.19 and 5.20).** Disabled learners expectations are related to studying MOOCs aligned to their interest, to learn online and to use MOOCs to find out if they can study at that level and prepare themselves for future studies. Data from both

sources show that disabled learners are likely to have previous experience in the subjects of the MOOCs they participate, but that there are learners entirely new to a subject that join the MOOC to get an initial general understanding in the subject and into online learning. Disabled learners are highly motivated when participating in MOOCs reporting an excellent opinion.

- **Open Education**. **Table 5.8.** The access to free MOOCs and Open education is a value-added and linked to low-income economic resources, as showed in the interviews and surveys.

- **Certification, professional development and access to HE. (Tables 5.8 and 5.11).** Data, in this case, show disagreement with the surveys indication less interest in their work or for CPD while in the interviews disabled learners value those aspects from MOOCs.

- **Leisure and finishing the MOOC. (Tables 5.11 and 5.14, 5.15, 5.16 and 5.17).** Regarding completion, interviews have shown the predisposition of learners to finish the MOOCs which is endorsed by survey data where disabled learners opted to take most of the MOOCs. Data from surveys are reporting that having enough time was not an issue while the interviews provide a different perspective with time availability being a common barrier. There is agreement with the lack of engagement in both data sources when the course progresses. Disabled learners' experiences show they enjoyed studying and would recommend MOOCs to others.

- **MOOC design. (Tables 5.11 - 5.17).** In general survey data is showing conformity with the MOOC structure and design, and that for disabled learners courses were too basic. Disabled learners in the interviews report barriers related to the content in the MOOC workload and in the MOOC structure.

- **Educational resources. (Tables 5.11 and 5.14, 5.15, 5.16 and 5.17).** Survey and interview data report disabled learners like reading articles and watching videos. They like to have alternative formats for educational resources to be delivered.

- **Discussion, assignments, tests and quizzes. (Tables 5.11 - 5.17).** Both data sources show some disabled learners are keen to do quizzes and tests, but they do not enjoy reading comments posted by other learners or discussing online. This is apparent in the interviews, however that cannot be generalised as some learners reported engaging with the practical and positive parts of the interaction.

- **Help: Report and feedback. (Table 5.11 and 5.18).** Both surveys and interviews show some learners did not even notice the existence of facilitators. Surveys report facilitators were active in responding to posts, adding helpful messages and being active, indicating satisfaction with facilitators (although with low numbers it was significant that there were cases reporting it was not good). In interviews the was greater criticism about the role facilitators could have played in providing help.

6.7 Discussion

In this section, the research findings and triangulation (**Sections 5.7, 6.5 and 6.6**) are broken down in the context of the research questions for this study and are guided by the thematic analysis from the interview data.

RQ2. What are the motivations of disabled learners when taking part in MOOCs?

To better understand the motivations of disabled learners when participating in MOOCs the theme "*learners motivations"* is used to expand upon the main perspectives.

Disabled learners' expectations depend on their previous learning experience. There is a general commitment and primary interest in the educational subject proposed in MOOCs. For learners MOOCs represent a friendly online environment compared to face-to-face educational experiences. MOOCs offer a broad number of subjects to be studied at their own pace. For some learners participating in MOOCs is their first experience with online learning. MOOCs enable disabled learners to access MOOCs on their own devices and being in their learning environment (home, work-place, etc.) helps towards self-confidence.

Low cost of MOOCs opens up opportunities to get basic understanding of topics as 'tasters'. MOOCs challenge learners with new educational stimulations. Free MOOCs allow access to learning for learners with low income and benefits everyone by facilitating personal development through high-quality educational materials. This may go against some of the business decisions applied by some of the MOOC providers in recent years.

Some disabled learners report that MOOCs are playing a decisive role in their personal development. Motivations for using MOOCs for learning are linked to both disabilities and personal situation of learners. They realise that MOOCs are useful for CPD and that the certification can be adding value to their CV. This achievement can demonstrate ability and interest in self-sufficiency in education to an employer. MOOCs need to be comprehensive enough to count for certification; certificates should provide detailed information on the learning that has been achieved.

Disabled learners understand that MOOCs can be useful as a route to HE. MOOCs can complement University courses or can be used as a resource to get an induction before accessing a University course. Some learners enjoy taking MOOCs for leisure, to keep their mind active, and for enjoyment.

RQ3. How can MOOCs be made accessible for disabled learners? - RQ3a. What is the current state of accessibility of MOOCs?

To understand how to make MOOCs more accessible (**RQ3**), the theme *"accessibility in MOOCs"* provides a multilevel perspective where *"barriers"* show the current state (**RQ3a**) and *"responses"* and *"solutions"* involve identification and addressing of barriers (**RQ3b**). Tables in this section are represented following the sub-theme *"MOOC structure"* which is based on the MOOC structure defined in **Section 2.5**. **Table 6.8** shows the barriers identified by the learners:

Table 6. 8. Main accessibility barriers identified by the learners

MOOC structure	Accessibility barriers and enablers
Platform design and access	• Designs across platforms • Registration and sign in • Devices • Offline access • Second Language
MOOC design	• Workload
Educational resources	• Videos • Text-based files • Images
Discussion, assignments, tests and quizzes	• Participation
Help: Report and feedback	• Facilitators

- **Platform design and access.** Learners interact with different MOOC platforms and their different design influences their behaviour. Difficulties to find how to achieve a task on the platform increases learners' anxiety. Learners face barriers using different browsers, not remembering their password and having to set it up again or updating information after registration. It is difficult to change the email address since in many cases it is linked to the learner's academic profile.

  Barriers are reported for platforms and MOOCs when being accessed with different devices, and access to content without internet connection may be minimal. Language is a barrier for those learners accessing them in a second language.

- **MOOC design.** Learners report having limitations to finish the week and MOOC workload on time. The design is affected by the chronological order of modules. The number of educational resources and assignments per week can be too few or too many and finding the right balance of time to watch or read the content can be challenging for a disabled learner.

- **Educational resources.** The lack of availability of subtitles and transcripts is a barrier for many learners, and so is the language barrier. The lack of accessibility of text-based files and images was also reported.

- **Discussion, assignments, tests and quizzes.** Participation in the assignments affect the discussions. Learners do not necessarily enjoy the connectivist approach of participation in the discussions. The forum's design increases the difficulties to find helpful content for learners, and not all learners enjoy being reviewed and reviewing others' assignments. The lack of guidelines on how to participate in discussions and peer to peer assignments (P2P) increases these barriers. Learners appreciate quizzes and test that provide feedback, but they are wary of trying them out against a time limit. They are also concerned about losing access to quizzes once the MOOC ends.

- **Help: Report and feedback.** Learners miss the presence of facilitators and help and feedback that they can provide, which can be a barrier for some learners.

RQ3. How can MOOCs be made accessible for disabled learners? - RQ3b. How can accessibility barriers in MOOCs be identified and addressed?

Responses to accessibility barriers by learners are shown in **Table 6.9**. Practical responses (underlined) and solutions proposed by the learners are presented in the table:

Table 6. 9. Main accessibility barriers responses and solutions by the learners

MOOC structure	Response to accessibility barriers	Solutions proposed to accessibility barriers
Platform design and access	• Abandonment • External tools	• Better and multilingual platform design • Profiling • Offline access
MOOC design	• Abandonment • Skipping parts • Re-join next run • Self-organisation	• MOOC information • Variety of tools • external links • MOOC structure • MOOC content access
Educational resources	• Use of subtitles and transcripts • External tools	• Alternative formats for educational resources • Videos design
Discussion, assignments, tests and quizzes	• Abandonment • Skipping assignment	• Optional assignments and tests • Discussion and assignment guidelines
Help: Report and feedback	• Tools: email and do it request	• Help guidelines • Facilitators • Discussions • Chat box • Social media

- **Platform design and access.** MOOC platforms design should be as simple as possible and, support several languages for usability. Platforms should add profiling options to allow learners to set up their default configuration and get recommendations on which MOOCs better fit their preferences. They should include tools, internal or external, to help learners, for example, dictionaries in several languages. They should add facilities to download the educational resources for low-quality internet connections. Platforms should provide access to the entire MOOC content in one go from the beginning and avoid removing the access to the MOOC when the scheduled study period finishes.

- **MOOC design.** Information to learners should include relevant details about the MOOC accessibility, a detailed syllabus and information about the previous knowledge needed. Other information that should be included are the learning goals to be achieved, the MOOC workload, information about next runs and previous courses in the same topic. MOOC design should find a balance between educational resources, quizzes and assignments to allow iteration and engagement. At the beginning of the MOOC, there should be clear information about how learners can ask for help.

- **Educational resources.** Educational resources should be provided in alternative formats such as subtitles and transcripts in several languages; transcripts need to be visible when the video is being played. The length of the videos and its design affect the engagement.

- **Discussion, assignments, tests and quizzes.** Some collaborative activities and assignments can create anxiety for learners. MOOCs should provide instructions on how to evaluate assignments when involved with peer-to-peer reviewing. Alternative pathways of learning for those who are not aiming for certification should be provided.

- **Help: Report and feedback.** There should be guidelines to indicate how to ask for help and report barriers. Several options were asked for: contact email, "do it" request form, use discussions to ask for help, a chat box and social media. Facilitators should be proactive in providing help.

Review of the RQs answered in this study

As shown in **Section 5.8** the number of disabled learners participating in MOOCs is lower than reported in other distance learning environments (Law et al., 2013) including at the OU (The Open University, 2018b). The sample analysed for this research has a predominance of older and female learners with limited academic background, and a higher proportion reporting unwaged with domestic responsibilities and retired. The presence of older learners in MOOCs had been previously reported by Liyanagunawardena and Williams (2016).

Previous research has identified motivations of learners participating in MOOCs (Ilgaz & Gulbahar, 2017; Watted & Barak, 2018) (**Section 2.7**). Disabled learners show interest in the educational subjects proposed by MOOCs, which are very broad from provider to provider, allowing flexibility and self-confidence as learners can study from wherever and whenever they want. Their previous experience is important but for some learners this is the first online learning experience. MOOCs offer a friendly environment compared to classroom attendance. The low-cost factor plays an important role, giving access to learners with low income and allowing them to test for themselves if they are really interested in the subject.

As Watted & Barak (2018) report for all learners, MOOCs can be useful for personal and CPD learning, including those who want to access HE via experience with MOOCs, as reported in disabled learner interviews and survey data. Certification can be included in the CV although not all learners consider it to be showing a learning achievement, which is aligned with Sablina et al. (2018) implying the lack of consistency in the measurement of achievement in MOOCs.

These interests do not differ from other learners identified in previous research (Liyanagunawardena et al., 2017; Shapiro et al., 2017). As we have seen in this section survey data and interviewing learners in the study being reported in this chapter has helped to develop a deeper understanding of the perspectives of disabled learners participating in MOOCs

6.8 Conclusions

Study A has provided the opinions of MOOC providers on how they cater for disabled learners (**RQ1**). Study B has served to give voice to disabled learners and understand what their motivations are for participating in MOOCs (**RQ2**). Both studies have shed light on how to improve accessibility in MOOCs (**RQ3**). Providers have given their views of the processes in which they treat accessibility (**RQ3a**) and how they work towards improvement of accessibility (**RQ3b**). Learners have reported the accessibility barriers they encounter (**RQ3a**) and how they addressed them or would like them to be solved (**RQ3b**).

More methods are required to answer **RQ3** as specified in the research design (**Section 3.3**). To complement this information and to lead a process to identify and address barriers, an HCI approach of heuristic

evaluation is introduced. The next two chapters will present the accessibility audit. Study C will take a holistic approach to collate both technical and learning design barriers in MOOCs to answer **RQ3**.

7. Study C: The design of the MOOC accessibility audit

The third study of this thesis is the MOOC accessibility audit. This HCI based study included design and validation processes with different experts and an implementation with a sample of representative MOOC providers. This chapter explores the design process. The following chapter contains analysis of the validation and implementation.

7.1 Introduction

The use of a MOOC accessibility audit gives an opportunity to assess the current state of accessibility in MOOCs platforms and courses, providing indicators of the accessibility barriers and then derive recommendations on how the barriers can be identified and addressed.

The chapter presents the design of the MOOC accessibility audit (in **Section 7.3)** where previous research is introduced and the inclusion of accessibility information by platform providers is explained (**Section7.3.1**), with the following subsections discussing in depth the design of each of the different accessibility audit components: technical accessibility (**Section7.3.2**), UX (**Section7.3.3**), quality (**Section7.3.4**) and learning design (**Section7.3.4**).

7.2 Research questions

In this study the focus is on addressing research question **RQ3** and its two sub-questions (**Section 2.7**):

- **RQ3**. How can MOOCs be made accessible for disabled learners?
    - **RQ3a**. What is the current state of accessibility of MOOCs?
    - **RQ3b**. How can accessibility barriers in MOOCs be identified and addressed?

7.3 The MOOC accessibility audit design

Study C has the research objective to understand how to improve the accessibility in MOOCs for disabled learners (**RQ3**). The results of the audit implementation help to understand the current state of accessibility in MOOCs (**RQ3a**). All the processes involved in the audit: the design, the validation and the implementation meet the objective of identifying and addressing accessibility barriers (**RQ3b**).

To inform the design of the accessibility audit, it is appropriate to revisit the different accessibility evaluation methods (AEMs). **Table 7.1** synthesises the different AEMs based on the literature reviewed by Brajnik (2008), Douce & Porch (2009) and Petrie & Bevan (2009). Brajnik and Petrie & Bevan classifications are intended to be applicable to any kind of software, while Douce & Porch focus on educational software. The table is classified following the alphabetical order of AEMs, the name selected to be used in this research is indicated in bold, and the description indicates why the terminology in bold was selected drawing from the chosen authors.

Table 7. 1. Review on different AEMs

AEMs	Authors	Description
• **Automated Checking** • Automated checking of conformance to guidelines and standards	• **(Douce & Porch, 2009)** • (Petrie & Bevan, 2009)	Automated checking tools can be used to provide guidance about whether digital resources conform to a number of accessibility guidelines
• Barrier walkthrough	• Brajnik (2008)	An accessibility inspection technique where the context of website usage is explicitly considered. An evaluator has to assess a number of predefined barriers which are interpretations of accessibility or usability principles
• Conformance reviews • **Heuristic Evaluations** • Evaluations conducted by experts	• Brajnik (2008) • **(Douce & Porch, 2009)** • (Petrie & Bevan, 2009)	It is based on checking if a page satisfies a checklist of criteria. It is an analytic method, based on evaluators' opinions, producing violated checkpoints
• Evaluation of data collected during system usage	• (Petrie & Bevan, 2009)	The evaluation that takes into account the use of the system in the testing period
• Economic Evaluations	• (Douce & Porch, 2009)	Evaluation around how much time a system takes to operate, or how much money it would cost to implement and maintain
• Field Evaluations	• (Douce & Porch, 2009)	Field evaluations are carried out in a situation where a product or system is likely to be used
• Pedagogic Evaluations	• (Douce & Porch, 2009)	Pedagogic evaluations aim to assess whether a system can facilitate learning.
• Perception Evaluation	• (Douce & Porch, 2009)	Evaluations around the attitudes that the various stakeholders may hold towards the proposed system since this is likely to influence whether it is likely to be accepted.
• Predictive Evaluations	• (Douce & Porch, 2009)	Predictive evaluations represent a range of techniques that are designed to predict the performance of a design change
• **Screening techniques** • Evaluations using models and simulations	• **Brajnik (2008)** • (Petrie & Bevan, 2009)	Informal empirical techniques based on using an interface in a way that some sensory, motor or cognitive capabilities of the user are artificially reduced
• Software Inspections	• (Douce & Porch, 2009)	Different developers debate the software internal design and quality, drawing upon the prior experience of other systems
• Subjective assessments • **End-user Evaluations** • Evaluation with users or potential users	• Brajnik (2008) • **(Douce & Porch, 2009)** • (Petrie & Bevan, 2009)	Based on a panel of users instructed to explore and use a given website by themselves, and later report feedback on what worked for them and what did not

As noted in the literature review (**Section 2.6**), there has been previous research addressing the evaluation of both accessibility and usability in MOOCs. **Table 7.2** summarises the identified papers and the AEMs applied.

Table 7. 2. Report papers: AEMs, sample and standard

AEMs				Authors	MOOC Sample and standard
Automated Checking	**Heuristic Evaluations**	**Pedagogic Evaluations**	**End-user Evaluations**		
No	Yes	No	No	(Akgul, 2018)	Anonymised (3 MOOCs) - WCAG 2.0
Yes	No	No	Yes	(Al-Mouh et al., 2014)	Coursera (10 MOOCs) - WCAG 2.0
No	No	No	Yes	(Bohnsack & Puhl, 2014)	Coursera, Udacity, edX, OpenCourseWorld and Iversity (1 MOOC per provider) - WCAG 2.0
Yes	No	No	Yes	(Bong & Chen, 2016)	edX (1 MOOC) - WCAG 2.0
Yes	No	No	No	(Calle Jimenez et al., 2014)	Coursera (1 MOOC) - WCAG 2.0

AEMs				Authors	MOOC Sample and standard
Yes	No	No	No	(Espada et al., 2014)	edX, MiríadaX, Udacity, MIT and Udemy (1 MOOC per provider) - W3C Best Practices & Usability.gov
Yes	No	No	Yes	(Ferati et al., 2016)	Almooc (2 MOOCs) - WCAG 2.0 & IBM Heuristics
No	No	No	Yes	(Królak et al., 2017)	Coursera (1 MOOC) - WCAG 2.0
Yes	Yes	No	No	(Martin et al., 2016)	Coursera, Udemy, edX, Futurelearn, Udacity, MiríadaX, NovoEd and UNED Abierta (1 MOOC per provider) - WCAG 2.0
No	No	Yes	Yes	(Park et al., 2015)	Coursera, edX and Khan Academy (1 MOOC per provider) - UDL
No	No	No	Yes	(Rizzardini et al., 2013)	Telescopio (1 MOOC)- WCAG 2.0
Yes	Yes	No	No	(Sanchez-Gordon & Luján-Mora, 2013b)	Coursera (1 MOOC) - WCAG 2.0
No	Yes	No	No	(Sanderson et al., 2016)	Canvas (1 MOOC) - ATAG 2.0
No	Yes	No	No	(Young, 2014)	Coursera (2 MOOCs) - Self-reported

Findings, in all the reported research, show different errors that would not achieve the basic level of accessibility (i.e. level A in WCAG) and design issues that mean disabled learners involved in the evaluations stop in the early stages of the evaluation. These studies show:

- **Limitations**. There are limits to the capability of automatic checks to ensure accessibility.

- **Combination of methods.** There are examples of research that have combined methods. These research projects have produced results that would not have been found without the use of several AEMs.

Different AEMs lead to different types of results, and so it is desirable to use complementary methods for accessibility evaluation. In this sense, the audit proposed can be considered as a methodology which combines the methods identified by each of the authors cited in **Table 7.1**. From Brajnik (2008) these methods are of conformance reviews, barrier walkthrough and screening techniques. In the case of Douce & Porch (2009), the methodology combines automated checking, heuristic evaluations and pedagogic evaluations. Finally, following the classification offered by Petrie & Bevan (2009), this instrument includes automated checking of conformance to guidelines or standards, evaluations conducted by experts and evaluation of data collected during system usage.

The concept of an accessibility audit first emerged in research conducted prior to this PhD (**Table 7.3**), the outcome of that earlier research can be considered as a pilot implementation of the MOOC accessibility audit.

Table 7. 3. **Pilot iterations of the audit**

AEMs			Authors	MOOC Sample
Automated Checking	**Heuristic Evaluations**	**Screening techniques**		
Yes	Yes	Yes	(Iniesto et al., 2014)	UNED Abierta and UAb iMOOC (1 MOOC)
Yes	Yes	Yes	(Iniesto & Rodrigo, 2014)	UNED Abierta, COLMENIA and MiríadaX (1 MOOC)

The methodology in the MOOC accessibility audit combines AEMs. As explained above, a range of AEMs has been considered to be included in the audit. One approach considered was to develop the audit in an

iteratively refined process through several implementations including and excluding methods to produce a checklist to evaluate MOOC platform and courses. A final refined version could then be reviewed by several accessibility experts. In practice a single-pass approach was adopted, so that instead of developing the audit including or removing methods during the implementations, a combination was selected subject to several premises considered:

1. **One implementation**. The audit is developed as a fully usable benchmark itself from the beginning. The audit may then be improved after it is implemented.

2. **Representativeness**. The implementation of the audit needs to cover a representative number of providers.

3. **Open access**. The audit will be available to MOOC providers. The audit uses free to use software and benchmarks available under open access (OA), either licenses or standards. Its components are delivered under creative commons license CC BY - Attribution[64]. This decision implies the commitment of the researcher with open and free to use software under CC licencing (Crowston & Howison, 2005). Software and benchmarks to fit that decision have been adapted and reused (Feller & Fitzgerald, 2002).

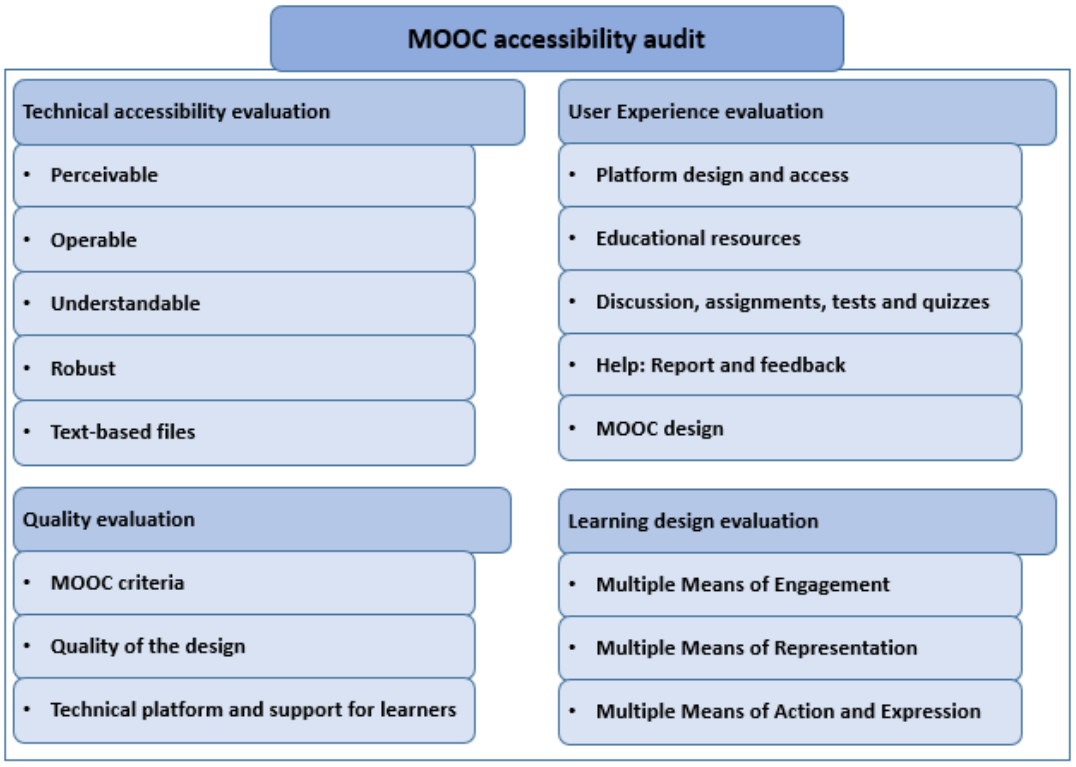

Figure 7. 1. The four components of the audit by principles

The different AEMs have been distributed into a benchmark formed by four checklists. The audit methodology combines them through four components, as shown in **Figure 7.1**, and the principles that

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compose them: technical accessibility evaluation, user experience (UX) evaluation, quality evaluation and learning design evaluation. **Table 7.4** specifies the principles and AEMs included in each of the audit components. The implementation includes a typology of information search of accessibility information by platform providers. It can be seen all the components include heuristic evaluation, which is the method that links the entire audit.

Table 7. 4. Accessibility audit components, guidelines and selected AEMs

Accessibility components	Principles	AEMs
Accessibility information by Platform providers		
1. Technical accessibility evaluation	1. Perceivable 2. Operable 3. Understandable 4. Robust 5. Text-based files	• Heuristic evaluations • Automated checking • Evaluation of data collected during system usage. • Screening techniques
2. UX evaluation	1. Platform design and access 2. Educational resources 3. Discussion, assignments, tests and quizzes 4. Help: Report and feedback 5. MOOC design	• Heuristic Evaluations • Barrier walkthrough • Automated checking • Pedagogic evaluations • Evaluation of data collected during system usage • Screening techniques
3. Quality evaluation	1. MOOC criteria 2. Quality of the design 3. Technical platform and support for learners	• Heuristic evaluations • Pedagogic evaluations • Evaluation of data collected during system usage
4. Learning design evaluation	1. Multiple means of engagement 2. Multiple means of representation 3. Multiple means of action and expression	• Heuristic evaluations • Pedagogic evaluations • Evaluation of data collected during system usage

The design process included a set of meetings with accessibility experts and raters. The roles of experts (EX) and raters (RT) can be seen in **Table 7.2**. A total of 10 people were involved in this process, some of them taking several roles in different components depending on their expertise. The distinction is made between experts, who have participated in the design, and raters, who have been involved in the validation process.

Table 7. 5. Accessibility audit by experts and raters

	Expert	Rater
General process	• (EX1 and EX2). 2 learning development managers (OU) • (EX3) 1 accessibility research manager (UNED)	
1. Technical accessibility evaluation	• (EX4). 1 learning development manager in evaluation (OU)	• (RT1) 1 Educational Technology Developer (OU)
2. UX evaluation	• (EX5) 1 accessibility research manager (UNED)	• EX4=RT2 • EX5=RT3
3. Quality evaluation	• (EX6) 1 program manager in quality projects (EADTU)	• (RT4, RT5) 2 PhD Research Students (OU)
4. Learning design evaluation	• (EX7) 1 member of the UDL cadre for CAST (OU)	• EX7=RT5

Experts have been included at the general design process level and in each one of the components of the audit itself, to help with the process of production and refinement of the content of the four checklists. As explained in the next chapter, raters validated the implementation. They were asked to provide feedback on the checklist content and ways to improve the component. **Figure 7.2** shows the meetings with experts and raters. The general process required 4 meetings. The first two meetings with the 3 experts were

dedicated to providing feedback on the general process of the audit, the last two meetings had the purpose to the evolution of the audit and its preliminary results. The calendar shown in the figure highlights the overlapping process of working with experts and raters. The audit has been designed with the idea of both validation and replication. For applying the audit in a practical setting, MOOC providers must be aware of the resources involved in the process, both in time and technical knowledge. This audit has a research purpose that may challenge the business perspectives of MOOC providers due to the time it requires to be applied. The audit requires an average value of a full day for the technical, UX and learning components and half a day for the quality component, per course and platform.

Resource requirements may be a limitation in its future reuse and would need to be considered outside the PhD research. Limitations are discussed further in the validation (**Section 8.3)** and in the discussion (**Section 8.5)**.

	2017		2018				
	Nov	Dec	Jan	Feb	Mar	Apr	May
General process	EX1 and EX2	EX3			EX1 and EX2 EX3		
Accessibility evaluation	EX4=RT2						RT1
UX evaluation		EX5=RT3				EX5=RT3	EX4=RT2
Quality evaluation	EX6	EX6		RT4	RT4 RT5 (x2)		
Learning design evaluation		EX7=RT5	EX7=RT5	EX7=RT5	EX7=RT5	EX7=RT5	

Figure 7. 2. Accessibility audit planning with experts and raters

To provide consistency the four checklists would share a standard set of characteristics:

1. All of the checklists are applied to evaluate the MOOC once it is being run.

2. All of the checklists share the same three structural levels:

    - **Principle**: the top level that joins a set of related guidelines.

    - **Guideline**: a group of criteria within a common topic.

    - **Criteria**: the checkpoints to evaluate.

3. All of the checklists share the same structure for every single criterion:

    - **What to test for**: information to help the evaluator to know what the criterion is evaluating.

    - **Testing method**: information to help the evaluator to proceed to test the criterion.

    - **Comments**: space for the evaluator to add free comments.

4. All of the checklists share the same rating method:

- **NA (Not achieved):** The feature to test is missing.
- **PA (Partially achieved):** The feature to test is available but not integrated.
- **LA (Largely achieved):** The feature to test is available and partially integrated.
- **FA (Fully achieved):** The feature to test is available and fully integrated.
- If the criterion is not applicable, ***"Not Applicable"*** is added to the comments

The use of *"What to test"* for and "*Testing method"* is based on the accessibility heuristic evaluation template by IDRC (**Section 1.2**), while the four evaluation criteria are taken from the OpenUpEd quality label benchmark.

As Brajnik, Yesilada, & Harper (2010) claim, heuristic evaluations can be complex and even produce wrong results (false positives). As the authors comment, several factors influence uncertainty in heuristic evaluations:

- The vagueness of the evaluation process may cause several evaluators to focus on different aspects that do not necessarily have to do with the criterion to be evaluated (Hertzum & Jacobsen, 2001).
- The individual decision for success or error is personal (Catani & Biers, 1998).

For these reasons a good definition of what should be evaluated and how the evaluation should be carried out has been developed to help the evaluator in all areas of the audit. In the *"Testing method"* the explanation provided aims to reinforce what a fully achieved item would be. Examples of golden items (i.e. fully achieved exemplifications) have been included when possible (Cook et al., 2009). Developing a rating system that has four different values seeks to avoid a system which considers that a criterion is only fulfilled or not fulfilled, by adding the nuance that a criterion can be partially or largely implemented, in addition the use of comments allows the opinion of the evaluator to be explained to enrich the feedback available.

In the next subsections, the processes for designing the different components of the audit are explained. The final version of the checklists is available in **Appendices 12 to 16**.

7.3.1 Accessibility information by platform providers

Following Stvilia et al. (2007) typology of information quality, this introductory section for the audit includes accessibility information about the 20 main providers (as selected in **Section 2.5**). This information is useful to answer **RQ3a** and to have a broad understanding of platform providers catering to accessibility. The gathered information includes:

- **Public accessibility policies for course providers**. Information provided publicly to course providers to aid them in adding a course into the platform. (Platform providers may share such information privately, in which case it cannot be evaluated).

- **Public accessibility statement for learners.** Information about the accessibility of the platform and its courses made publicly to learners on the website.

- **Accessibility help contact.** Information for learners to report or contact for help on accessibility barriers in the provider website.

7.3.2 Technical accessibility evaluation

The WCAG-EM methodology is used for this component, decisions to comply with it are detailed in **Table 7.6.**

Table 7. 6. WCAG-EM steps and decisions

WCAG-EM	Decision was taken
1. Define the scope of the evaluation	In the evaluation are included the platform and the MOOC. Level AAA
2. Explore the website	Analysis of accessibility evaluation tools to be used for the audit
3. Select a representative sample	8 representative web pages and 2 text-based files
4. Evaluate the selected sample	Checklist based on WCAG 2.0 including instructions for the evaluator based on the MOOC environment
5. Report the evaluation findings	A ranking method is provided for each criterion

The checklist proposed for this part of the audit is developed from the one used by the IDRC (**Section 1.2**). That checklist initially focuses on success criteria that are mandated by the Accessibility for Ontarians with Disabilities Act (AODA)[65] including levels A and AA. EU Web and Mobile Accessibility Directive[66] recommends level AA of accomplishment for websites, and countries in Europe have reflected that level as their standard in their legislation including the UK[67]. The checklist has been adapted to MOOCs and extended to level AAA, including Accessible Rich Internet Application[68] (ARIA) indications when possible. The evaluation of PDFs has been added as part of the educational resources included in MOOCs.

Note that in June 2018, following the data collection of the study, WCAG 2.1[69] guidelines were released. The updated guidelines include specific criteria for learners with cognitive or learning disabilities and with low vision, and access from mobile devices is included. WCAG 2.1 comprises 17 new criteria (5 A, 7 AA and 5 AAA). In August 2018, Standard EN 301 549 *"Accessibility requirements suitable for public procurement of ICT products and services in Europe"* [70] was published including this update. As WCAG 2.1 appeared after the data was collected, these guidelines are considered as a future improvement (**Section 9.6**).

In deciding which evaluation tools to be used, it is relevant to consider the weaknesses automated accessibility tools have (Duran, 2017; Vigo et al., 2013). The design of the audit includes a combination of several methods to enhance their strengths and to overcome their weaknesses; Martin et al. (2016) have also used this approach to evaluate accessibility in MOOCs. Automatic tools only cover part of the WCAG criteria, and there are criteria that no tool can cover and need manual evaluation (for example, an automatic

[65] AODA, https://accessontario.com/aoda/
[66] EU Web and Mobile Accessibility Directive, https://ec.europa.eu/digital-single-market/en/web-accessibility
[67] Legislation UK, http://www.legislation.gov.uk/accessibility
[68] WAI ARIA, https://www.w3.org/TR/wai-aria-1.1/
[69] WCAG 2.1, https://www.w3.org/TR/WCAG21/
[70] Standard - EN 301 549, http://mandate376.standards.eu/standard

tool cannot check if the alternative text of an image is suitable for describing its content, or judge whether missing alternative text means the image is just decorative or that alternative text is vital for the learner and has not been provided).

Table 7. 7. Free to use tools for accessibility evaluation

	Type	Validation
Reporting Tools		
TAW	Test Online, Test Mobile, Client	WCAG 1.0, WCAG2.0, HTML, CSS, JavaScript
Cynthia Says	Web	WCAG 2.0
eXaminator	Web	WCAG2.0
achecker	Web	WCAG2.0
AccessMonitor	Web	WCAG 1.0, WCAG 2.0
EIII	Web	WCAG 2.0
FAE	Web	WCAG 2.0
PAVE	Client	
PAC3	Client	
Debugging Tools		
WAVE	Web, Plug-in	WCAG 1.0, WCAG 2.0
aXe	Plug-in	WCAG 2.0
W3C HTML Validator	Web	HTML, XHTML, SVG, SMIL
WDG HTML Validator	Web	HTML, XHTML, SVG, MathML, SMIL
Nu Html Checker	Web	HTML
W3C CSS Validator	Web	CSS, SVG
HTML CodeSniffer	Web	WCAG 2.0
Web Accessibility Toolbar	Plug-in	WCAG 2.0
Web Developer Toolbar	Plug-in	WCAG 2.0
aDesigner	Client	WCAG 2.0
Zoom Text Only	Plug-in	WCAG 2.0
Contrast checker	Plug-in	WCAG 2.0
HeadingsMap	Plug-in	WCAG 2.0
NVDA	Client	
ChromeVox	Client	
TPG Colour Contrast Analyser	Client	WCAG 2.0
Color Oracle	Client	WCAG 2.0
Responsive Design Simulator	Web	

Table 7.7 identifies free to use tools available for the audit[71]. Reporting tools produce a detailed report of the accessibility within the webpage using its URL. Many reporting tools do not work correctly in MOOC platforms since the platforms use HTTPS protocol under a login, not letting automatic reporting tools have access. A heuristic approach with manual evaluation using complementary tools that work over the session is therefore preferred. **Table 7.8** identifies automatic debugging tools which support going through the session.

To complement WCAG evaluation in text-based files (i.e. PDFs), PAC was decided as it evaluates ISO 14289-1 (PDF/UA) (2014)[72] standard for accessibility enhancement with the Matterhorn protocol[73]. ISO is the standard to evaluate accessibility in PDFs while Matterhorn is a comprehensible protocol for reporting accessibility barriers.

Table 7. 8. Tools to be used for the accessibility evaluation

User agent	Plugins
Chrome	WAVE

[71] Web Accessibility Evaluation Tools List https://www.w3.org/WAI/ER/tools/
[72] ISO 14289-1 (PDF/UA) https://www.iso.org/standard/64599.html
[73] Matterhorn protocol https://www.pdfa.org/publication/the-matterhorn-protocol-1-02/

User agent	Plugins
	Web Developer Toolbar Zoom Text Only Contrast checker HeadingsMap
Firefox	Web Developer Toolbar
Internet Explorer	
Screen reader	NVDA (Firefox) and ChromeVox (Chrome)
Contrast	TPG Colour Contrast Analyser, Contrast Checker and Color Oracle
PDF	PAC3

The sample for the accessibility evaluation includes 8 key webpages representing both the platform and the MOOC (**Table 7.9**). Text-based documents include MOOC self-produced PDFs and PDFs related to the platform use.

Table 7. 9. The representative sample for the accessibility evaluation

Sample	Pages
Platform	• The platform's homepage. • The registration\login page • The courses search engine
MOOC	• The course homepage • The coursework schedule • A course page including video lesson. • A course page including test or p2p. • A course page including forum or discussion
Text-based	• PDF MOOC self-produced • PDF with guidelines about technical and pedagogical indications produced by the platform

For the development of this component of the audit there was a meeting with one expert. The following criteria are part of the MOOC accessibility: 22 *"perceivable"*, 20 *"operable"*, 18 *"understandable"*, 2 *"robust"* and 3 *"text-based files"*, being 65 in total (**Table 7.10**), the five principles for the accessibility evaluation are:

1. **Perceivable**. The site must provide text alternatives for non-text content, alternatives for time-based media, layout alternatives for related or sequential content, and generally make sure all content is easy to see and hear (22).

2. **Operable.** The site must provide keyboard access, enough time to read and use content, orientation, clear navigation, and organised content. A site must also operate safely without flashing (20).

3. **Understandable.** Content must be readable, consistent, and predictable. Instructions must be clear and helpful (17).

4. **Robust.** Content must be compatible with a variety of user agents and assistive technologies (2).

5. **Text-based files**. PDF files need to include basic requirements, logical structure and metadata and settings (3).

Table 7. 10. **Accessibility principles and guidelines**

Principle	Guideline	Criteria	Total
Perceivable	1.1 Text Alternatives	1	22
	1.2 Time-based Media	9	
	1.3 Adaptable	3	
	1.4 Distinguishable	9	
Operable	2.1 Keyboard Accessible	3	20

Principle	Guideline	Criteria	Total
	2.2 Enough Time	5	
	2.3 Seizures	2	
	2.4 Navigable	10	
Understandable	3.1 Readable	6	17
	3.2 Predictable	5	
	3.3 Input Assistance	6	
Robust	4.1 Compatible	2	2
Text-based files	5 Accessible PDF	3	3
			64

The final version of this checklist is available in **appendix 12**.

7.3.3 User experience evaluation

The UX evaluation uses cognitive walkthroughs and UX walkthroughs that use of engaging and goal-directed personas (Holzinger, 2005; Nielsen, 2013) (as explained in **Section 3.6.2**). The profiles from disabled learners interviewed in Study B are used to develop the personas. These profiles meet all the requirements to act as personas making use of real characteristics such as their background, their personal interests, their experience participating in MOOCs and the accessibility barriers encountered.

Personas development typically starts with a large number of personas, in this case, the full sample of 15 learners from Study B (**Section 6.3**). In a refinement process, these personas are combined to provide a persona for each kind of user needed. To identify any additional elements for the personas, examples provided by WebAIM[74] were followed to combine characteristics derived from the interviews with invented elements to complete gaps in their profiles, such as specific devices or assistive technologies used to participate in MOOCs. After refinement, the final suggested number is between 3 and 5 personas (Nielsen, 2012). **Table 7.11** shows the main characteristics used to set up the narrative of the personas based on Calvo (2017).

Table 7. 11. Characteristics developed for the personas

Characteristic	Real	1-n	Values	
Age	Yes	1	26-35, 36-45, 46-55, 56-65, 65 +	Young learner (26- 35) Middle age learner (36-55) Mature learner (56+)
Gender	Yes	1	Male or Female	
Native speaker	Yes	1	Yes (English) or No	
Educational qualification	Yes	1	School-leaving qualification, Undergraduate, Postgraduate, No formal qualification, College diploma	
Employment status	Yes	1	Full-time employed, Disabled and not able to work, Retired, Unwaged and seeking employment, Unwaged with domestic responsibilities, Full-time carer for severely disabled familiar	
Disabilities	Yes	1-n	Partially sighted, Hard of hearing, Restricted mobility, Restricted manual skills, Learning difficulties, Personal Care Support, Mental health, Fatigue or pain, Unseen disabilities	
Experience with MOOCs	No	1	Low, Medium or High	
Interest in MOOCs	Yes	Text	Free text	
Example of a barrier to Learning	Yes	Text	Free text	
Habits while accessing to MOOCs	No	Text	Free text	
Setting up the scenario. Devices, assistive technologies and user agent	No	Text	Free text	

[74] WebAIM, https://webaim.org/resources/

The refined personas are *Matthew, Martha, Deborah* and *Rebecca*. These are developed from the samples with the same name in section 6.2.3, with *Rebecca* being a joined persona with *Alexia*, which means *Rebecca* has acquired characteristics from *Alexia* to strengthen the persona. A brief summary of the personas is given in **Table 7.12**. Personas are available in **Appendix 14** as a table structure that follows usability.gov[75] recommendations.

Table 7. 12. Personas summary

Persona	Main Characteristics	Scenario set up
Matthew	Middle age learner, native speaker with school-leaving qualification, he is unwaged and seeking for a job with mental health difficulties and high experience using MOOCs	laptop with Mozilla Firefox on a Windows 7, he uses the laptop mouse pad
Martha	Middle age learner, native speaker, undergraduate. She is disabled and not able to work, partially sighted, restricted mobility, restricted manual skills, fatigue and chronic pain. High experience in MOOCs	Windows magnifier, or screen reader on google chrome. Desktop computer configuration
Deborah	Mature learner, native speaker, with school-leaving qualification, a full-time carer for severely disabled familiar. She has hard of hearing and high experience in MOOCs	Desktop computer with windows
Rebecca	Young Learner, a non-native speaker, postgraduate. She is full-time employed with dyslexia and low experience in MOOCs	Android with chrome

The approach used for the audit is that the evaluator can decide between four different ratings and so for each of the scenarios every task is divided to be evaluated through these ratings. The space provided for comments includes the four personas, so that this space enables the evaluator to respond as if from a focus group where personas are providing their opinion, and the evaluator is who decides an agreed rating (McAndrew et al., 2012). **Table 7.13** shows the tools that are available to help the evaluator to simulate the task proposed in the scenarios. In the study the first two weeks of the MOOC were considered to be representative.

Table 7. 13. Tools to be used for the UX evaluation

User agent	Plugins
Chrome	Web Developer Toolbar
Firefox	Web Developer Toolbar
Screen reader	NVDA
Disability simulator	aDesigner
Design Simulator	Responsive Design Simulator

Walkthroughs were designed following the MOOC structure specified in **Section 2.5**. These were 9 cognitive walkthroughs covering *"platform design and access", "educational resources", "discussion, assignments, tests and quizzes"* and *"help: report and feedback"*, and 2 UX walkthroughs addressing *"MOOC design"*. For this component, there was a meeting with one expert to coordinate the design of scenarios and personas.

Table 7.14 shows the 23 criteria for the audit: 6 in *"platform design and access"*, 4 in *"educational resources"*, 7 in *"discussion, assignments, tests and quizzes"*, 2 in *"Help: Report and feedback"* and 4 in *"MOOC design"*. The principles developed for the UX evaluation are:

1. **Platform design and access.** The platform includes the registration and sign-in forms and general search (6).

[75] Personas, https://www.usability.gov/how-to-and-tools/methods/personas.html

2. **Educational resources.** In the educational resources leaners have to interact with different formats including multimedia (videos), readings embedded in the webpage (articles) and text-based (files) (4).

3. **Discussion, assignments, tests and quizzes.** MOOCs usually include interaction with other learners in discussions and forums. Assignments can be individual or P2P. Tests and quizzes act to evaluate the learning and provide feedback (7).

4. **Help: Report and feedback.** When participating in MOOCs learners may need to report an accessibility barrier or to ask for help (2).

5. **MOOC design.** MOOC design needs to consider the workload, organisation and the syllabus provided to learners (4).

Table 7. 14. **UX principles and guidelines**

Principles	Guideline	Criteria	Total
Platform design and access	1. Registration and sign in	3	6
	2. Search and navigation	3	
Educational resources	3. Video	1	4
	4. Article	1	
	5. Electronic file	2	
Discussion, assignments, tests and quizzes	6. Assignment	3	7
	7. Discussion	2	
	8. Quiz-Test	2	
Help: Report and feedback	9. Help	2	2
MOOC design	10. MOOC experience	2	4
	11. Week experience	2	
			23

The final version of the personas and checklist is available in **Appendix 13**.

7.3.4 Quality evaluation

The CODUR[76] project (2017) performed a systemic comparison of current online education quality assurance tools and systems where researchers made a comparison of a variety of benchmarking and QA systems, one of which is OpenUpEd highlighting its simplicity and structure. Several research projects have based their quality work on the OpenupEd label, refining and adapting its checklists, including Score 2020 and BizMOOC. BizMOOC version has been used as a template to develop the criteria for the accessibility audit, a summary of the original criteria can be seen in **Table 7.15**.

Table 7. 15. Checklist, dimensions and number of criteria

Checklist	Dimension	Criteria	Total
Is it a MOOC or not?	Massive	1	13
	Open	5	
	Online	1	
	Course – study unit	1	
	Full course	5	
Quality of the design of MOOC	Target group	3	32
	Workload	2	
	Overall goal	1	
	Learning Objectives / Outcomes	5	

[76] CODUR http://in3.uoc.edu/opencms_in3/opencms/webs/projectes/codur/en/index.html

Checklist	Dimension	Criteria	Total
	Learning activities	5	
	Content / Assets	6	
	Feedback mechanism	6	
	Assessment	4	
Visibility	Project	6	6
Accessibility	Web-accessibility	2	6
	Accessible Information	3	
	Accessible learning	1	
Technical platform and support for staff and participants	Platform	2	12
	Staff support	3	
	Support for MOOC participants	7	
			69

There are several aspects to consider when using OpenUpEd as a benchmark:

- Every platform provider has quality criteria for the MOOCs to be designed against.
- The checklist is not designed to be used by experts.
- It is oriented towards self-assessment, where the provider is expected to reflect on their own MOOC production to provide a first measure on the strengths of performance and areas for improvement.

Therefore, the checklist had to be updated with the following aspects:

- The language used to be changed and oriented to evaluate MOOCs that are already produced and being run.
- Select the criteria, from the original list, that are still applicable taking into account that the MOOC is already produced.

To achieve the refined checklist, two meetings with the expert were organised to select the criteria to be included. **Table 7.16** shows the dimensions (guidelines) or checklist (principles) and the decision taken.

Table 7. 16. Dimensions which needed clarification

Dimension	Clarification	Decision was taken
Massive	The concept of massiveness applied to the number of facilitators required and learners (>150)	To remain in the checklist
Course	Study unit European Credit Transfer and Accumulation System (ECTS) was updated into a number of hours	To remain in the checklist
Target group	The target group is focused on those who design the MOOC. The decision was to reword it to make it more general	Partially removed from the checklist
Learning Objectives / Outcomes	Needed to clarify Lifelong learning, and to add some clarity in the feedback process	To remain in the checklist as learning goals
Content / Assets	The Assets had to be defined as a variety of options and possibilities for learning.	Partially removed from the checklist as educational resources
Feedback mechanism	Feedback can be provided in different ways (course team or automatic) and needed to be defined	To remain in the checklist
Visibility (checklist)	Focused internally on the organisation	To be removed
Accessibility (checklist)	Redundancy with the rest of the checklists of the audit	To be removed
Platform	Clarification on the possibility to delete the profile and private data, a clear definition of reliable and the distinction between the language of the MOOC and the platform were added	To remain in the checklist
Staff support	Focused internally on the organisation	To be removed
Support for MOOC participants	Redefinition on the use of social networking depending on the pedagogical approach of the MOOC and to provide help	To remain in the checklist as support for MOOC learners

The quality evaluation is the only component of the audit that being an adaptation did not have three levels of depth, each of the criteria has been named individually to identify the aspect to be evaluated. The checklist is structured as indicated in **Table 7.17**, with the following criteria: 13 *"MOOC criteria"*, 30 in "*the quality of the design"* and 9 in "*the technical platform and support for learners"*, 52 criteria in total. The three principles that shape quality evaluation are:

1. **MOOC criteria.** Based on the MOOC definition provided in **Section 2.5**. (13)

2. **Quality of the design.** The quality of the design evaluates aspects such as target groups, the schedule, the overall goal, the learning goals, the assignments, the educational resources, the feedback provided by facilitators and the learning goals assessment. (30)

3. **Technical platform and support for learners:** The reliability of the MOOC platform and access the learners have to the learning environment. (9)

Table 7. 17. Quality principles and guidelines

Principle	Guideline	Criteria	Total
The MOOC criteria	1.1 Massive	1	13
	1.2 Open	5	
	1.3 Online	1	
	1.4 Course	1	
	1.5 Full course	5	
Quality of the design	2.1 Target group	2	30
	2.1 Workload	2	
	2.3 Overall goal	1	
	2.4 Learning goals	5	
	2.5 Learning activities	5	
	2.6 Educational resources	5	
	2.7 Feedback mechanism	6	
	2.8 Assessment	4	
Technical platform and support for learners	3.1 Platform	2	9
	3.2 Support for MOOC learners	7	
			52

The final version of this checklist is available in **Appendix 15**.

7.3.5 Learning design evaluation

The Learning design evaluation uses the formative framework of UDL. UDL is based on three principles: "*multiple means of engagement"*, *"multiple means of representation"* and *"multiple means for action and expression"* (Meyer et al., 2014). UDL promotes the aim to design learning environments that develop expert learners defined as: *"purposeful and motivated"*, *"resourceful and knowledgeable"*, and *"strategic and goal-directed"* (CAST, 2014).

The guidelines used are version 2.1 (CAST, 2014), the most recent version of the guidelines available at the time of design of the audit. (Note UDL guidelines, version 2.2 were later released (CAST, 2018) updated in offering a new look and enriching their examples.) The principles outline the overall goal while checkpoints provide specific design advice that considers accessibility and learning. UDL guidelines are organised

following the three principles of the framework: representation, expression, and engagement. Every principle is divided into guidelines and every guideline in checkpoints (**Table 7.18** based on CAST (2018)).

Table 7. 18. UDL principles and guidelines

	Provide multiple means of Engagement	**Provide Multiple Means of Representation**	**Provide Multiple Means of Action and Expression**
Access	Provide options for recruiting interest	Provide options for perception	Provide options for physical Action
Build	Provide options for sustaining effort and persistence	Provide options for language & symbols	Provide options for expression & communication
Internalise	Provide options for self-regulation	Provide options for comprehension	Provide options for executive functions
Goal	**Purposeful and motivated**	**Resourceful and knowledgeable**	**Strategic and goal-directed**

The design of the criteria for this checklist to be applicable in the study required new development in the sections *"What to test for"* and *"Testing method"*. For each of the criteria, examples of UDL proposed by CAST[77] have been used to prepare specific cases in MOOCs. This has been an iterative process with the expert in this area, who also acted as the rater for the validation of the results. The two meetings with the expert served different purposes: the first meeting had the objective of setting the principles of UDL in its relationship with MOOCs. The second meeting was used to carry out a process of testing the checklist on a MOOC of FL to teach the researcher more about use of UDL, this pilot of the UDL checklist dot form part of the study sample.

Table 7.19 shows the selected criteria, which give a criterion for each of the checkpoints in the UDL framework. 31 Criteria are distributed as follows: 10 for *"Multiple Means of Engagement"*, 12 for *"Multiple Means of Representation"* and 9 for *"Multiple Means of Action and Expression"*. Learning design principles are defined as:

1. **Provide multiple means of engagement.** Learners differ in how they may feel involved and motivated to learn. Therefore, it is necessary to offer options that reflect their interests, strategies to face new tasks, choices for self-evaluation and reflection on their expectations. (10)

2. **Provide multiple means of representation**. Learners differ in the way they perceive and understand the information presented. It is necessary to offer different options to approach contents through various channels of perception (e.g. auditory, visual or motor), and to provide the information in a format that allows being adjusted by the learner. (12)

3. **Provide multiple means for action and expression**. Learners differ in how they can work in the midst of learning and express what they know. It is necessary to offer options for action through educational

[77] UDL implementation examples, http://udlguidelines.cast.org/

resources with which all learners can interact, facilitate fluent opinions, and support stimulation of effort and motivation towards a goal. (9)

Table 7. 19. Learning design principles and guidelines

Principle	Guideline	Criteria	Total
Provide Multiple Means of Engagement	Provide options for recruiting interest	3	10
	Provide options for sustaining effort and persistence	4	
	Provide options for self-regulation	3	
Provide Multiple Means of Representation	Provide options for perception	3	12
	Provide options for language, mathematical expressions, and symbols	5	
	Provide options for comprehension	4	
Provide Multiple Means of Action and Expression	Provide options for physical action	2	9
	Provide options for expression and communication	3	
	Provide options for executive functions	4	
			31

The final version of this checklist is available in **Appendix 16**.

7.4 Conclusions

In this chapter, the design of the MOOC accessibility audit has been detailed. This audit is formed of different components that have required in each case a process of review of previous research, training, design and support from experts.

Table 7. 20. Accessibility audit components adaptations

Checklists	Adaptation	New development
Accessibility information by Platform providers	▪ NO	✓ YES
1. Accessibility evaluation	✓ YES	✓ YES
2. UX evaluation	▪ NO	✓ YES
3. Quality evaluation	✓ YES	▪ NO
4. Learning design evaluation	▪ NO	✓ YES

Table 7.20 summarises the design processes:

- **Accessibility information by Platform providers.** The capture of accessibility information provided by platforms providers. This is required for the study rather than forming part of the audit.

- **Technical accessibility evaluation.** Accessibility evaluation through WCAG is a recognised practice within online educational environments. This has required an adaptation for MOOCs and a new development to analyse text-based files.

- **UX evaluation.** The UX evaluation has required a new development for this audit, building on personas derived from the interviewees together with narrative scenarios.

- **Quality evaluation**. The evaluation of quality has considered a version of OpenUpED framework, with its consequent adaptation.

- **Learning design evaluation.** Finally, the use of UDL has meant the implementation of the framework specialised for MOOC evaluation.

The audit validation described in the next chapter uses a framework of inter-rater reliability testing to explore if the audit helps to identify and address barriers (**RQ3b**) and the reviews the results of the implementation to understand the current state (**RQ3a**).

8. Study C: The validation and implementation of the MOOC accessibility audit

This chapter presents the inter-rater reliability process, carried out with 6 experts to validate the audit, and discusses the data gathered from the implementation of the audit. Both processes share the same sample of MOOCs from 4 different platform providers: FL, Coursera, edX and Canvas.

8.1 Introduction

The chapter starts details the data collection (**Section 8.2)**, followed by the validation (**Section 8.3**) and implementation (**Section 8.4**) of the audit. **Section 8.5 and 8.6** include discussion and conclusions. The validation and implementation each follow the same structure: data analysis (**Section 8.3.1 and 8.4.1**) and then findings from each of the accessibility audit components (**Sections 8.3.2-8.3.5 and 8.4.2-8.4.5**).

8.2 Data collection

As introduced in the audit design (**Section 7.3**) a representative number of MOOCs is needed in order to validate the audit itself, to identify and address accessibility barriers (**RQ3b**) (**Section 8.3**) and be adequate to gain an overview of the state of accessibility in MOOCs (**RQ3a**) (**Section 8.4**).

8.2.1 MOOC selection

The selection process started from the 20 platform providers discussed in **Section 2.5**, with the following criteria applied in accord the research design perspective (**Section 3.3**):

1. **Full course experience.** Based on the MOOC definition provided in **Section 2.5**, MOOCs that offer a full course experience are preferred over self-paced MOOCs, so that the audit can be applied to evaluate interaction between learners.

2. **LMS.** Platforms should be built on different LMS (e.g. only one platform using Open edX is included).

3. **Study B.** Sufficient interviewees in study B who used each platform.

4. **Active MOOCs.** MOOCs are active in an open run during the evaluation to provide access to a fully operative MOOC (i.e. not an archived MOOC).

5. **Course Provider.** To allow discussion between the same educational level peers MOOCs are provided by Universities.

6. **HESA**. To flag possible barriers related to the learning design, MOOCs belong to different HESA subject categories.

8.2.2 Sample

Table 8.1 shows the MOOC providers considered for the sample applying the above criteria (between parenthesis in the column headings). The final selection is highlighted in bold (FL, Coursera, edX and Canvas). The data in this table is self-produced by the researcher and by Class Central (Shah, 2017).

Table 8. 1. MOOC platform sample selection

Platform Provider	Full course experience- Self-paced (1)	LMS (2)	Study B (3)	Selected
FL	667-0 (100%)	Proprietary software	15	✓ YES
Coursera	2853-0 (100%)	Proprietary software	6	✓ YES
edX	1813-1214 (33%)	Open edX	3	✓ YES
Open2Study	50-3 (94%)	Proprietary software	2	• NO
NovoEd	83-1 (98%)	Proprietary software	1	• NO
Canvas	477-123 (74%)	Canvas VLE	1	✓ YES
Stanford Online - Lagunita	68-52 (24%)	Open edX	1	• NO
Udemy	5-5 (0%)	Proprietary software	1	• NO
FUN	N/A	Open edX	1	• NO
Udacity	198-192 (3%)	Proprietary software	0	• NO
MiríadaX	208-0 (100%)	Proprietary software	0	• NO
Iversity	110-37 (64%)	Proprietary software	0	• NO

The four MOOCs selected for the audit can be seen in **Table 8.2** and include four categories by HESA: physical sciences, education, mathematical sciences and biological sciences.

Table 8. 2. MOOC sample selection

Platform Provider	Active MOOC (4)	Course Provider (5)	HESA (6)
FL	Basic Science: Understanding Experiments	The Open University	Physical sciences
Coursera	Learning How to Learn: Powerful mental tools to help you master tough subjects	University of California, San Diego	Education
edX	Introduction to Computational Thinking and Data Science	MIT	Mathematical Sciences
Canvas	Biometric Technologies: Identification for the Future	Canberra Institute of Technology	Biological sciences

For the accessibility evaluation, the representative sample within the MOOC is as indicated in **Section 7.3.2**. The first two weeks of each MOOC are taken into consideration for the UX, quality and learning design evaluation.

This sample has acknowledged limitations in using a single MOOC from each provider as MOOCs from diverse course providers could perform differently on the same platform provider. The study also does not cover some worldwide platforms including non-English based MOOC providers. Limitations are expanded in **Section 9.5**.

8.3 The validation of the audit

This section outlines the validation of the MOOC accessibility audit through an assessment of inter-rater reliability.

8.3.1 Data analysis

The research approach proposed for the audit considers the training and learning processes of the evaluator when using its checklists. For the validation of the audit an inter-rater reliability process has been followed that includes raters who evaluate the results and validate if the coincidence in common criteria is acceptable (Hallgren, 2012). The process allowed for improvement to the audit design in the following aspects:

- **Testing information.** Enriching the information provided in the *"what to test for"* and *"testing method"* sections.

- **Golden items**. Adding golden items (i.e. fully achieved exemplifications) to guide examiners to understand what *"fully achieved"* exemplifies.

This process and its derived improvements are expected to facilitate a future evaluator's learning curve. Inter-reliability meetings were scheduled in parallel with expert meetings as indicated in the previous chapter (**Section 7.3**). Minor changes proposed by the raters were accepted, with more substantial changes considered for future improvements. When applying inter-rater reliability it is desirable to use external raters, to avoid the researcher to participate in the process of rating (Cook et al., 2009). In this case, the researcher is one of the raters, which is justified since the validation process involves the improvement of the tool and the researcher needed to gain experience in its application.

To determine inter-rater reliability Cohen's Kappa coefficient was the statistic method selected as appropriate for comparison of two raters. Other options such as joint probability were considered, however it is less robust and disagreement in the audit depends on various factors such as the rater expertise and the criteria complexity, making Cohen's Kappa more suitable (McHugh, 2012). **Table 8.3** summarise the information on the raters for each of the audit components. In the UX and learning design evaluations the same person acted as both expert and rater.

Table 8. 3. Accessibility audit by raters

Accessibility audit	Rater	Institution
1. Accessibility evaluation	• Educational Technology Developer (RT1)	OU
2. UX evaluation	• Learning development manager in evaluation (RT2) • Accessibility Research manager (RT3)	OU UNED
3. Quality evaluation	• Two PhD Research Students (RT4 and RT5)	OU
4. Learning design evaluation	• Member of the UDL Cadre for CAST (RT6)	OU

Each of the MOOCs included in the sample for the implementation had two inter-rater reliability evaluations, as shown in **Table 8.4**. The technical accessibility evaluation had one inter-rater reliability evaluation. As discussed in **Sections 3.3.1 and 7.3.2**, this component has been used in previous MOOC accessibility evaluations and also requires a technical level of speciality. In contrast, the learning design component design has required extensive work in criteria development and therefore had three inter-rater reliability evaluations. The UX and quality audit component each had two inter-rater reliability evaluations.

Table 8. 4. Accessibility audit sample validation

Accessibility audit	FL	Coursera	edX	Canvas
1. Accessibility evaluation	RT1			
2. UX evaluation	RT2		RT3	
3. Quality evaluation		RT4		RT5
4. Learning design evaluation		RT6	RT6	RT6

The inter-rater reliability evaluation followed a systematised process that included two meetings per evaluation. The first meeting prior to the evaluation was to agree the indications provided in the checklists (i.e. the evaluation information) were understood by the rater. In the second meeting, the results of the evaluation were discussed. In case of discrepancy an agreement was then reached between the evaluators on how that particular criterion should be qualified (Cook et al., 2009). Terminology used in the next sections that describe this process includes:

- **Evaluators**. The researcher is the PhD research student, the rater is the external evaluator, evaluators are both the researcher and the rater.

- **Success, failure and not applicable**. Success criteria are considered fully achieved (FA) and largely achieved (LA), failures are considered partially achieved (PA) and not achieved (NA). Not applicable are those criteria which are not applicable (NAP) to the evaluation.

- **Agreement.** Evaluators can be in agreement that is either perfect agreement and moderate agreement.

- **Perfect agreement.** A perfect agreement is considered when the evaluators gave the exact same rating to a criterion (e.g. FA vs FA, NA vs NA).

- **Moderate agreement.** Moderated agreement is when the rating given by the evaluators differs within the same group (success or failure) and the final rating was then discussed and agreed. A moderate agreement also occurs if a criterion was considered initially NAP by one of the two evaluators.

- **Disagreement.** The rating between the evaluators differed between success or failure (e.g. PA vs FA or NA vs FA).

- **Final agreement.** The final rating as discussed and agreed.

All raters had access to the sampled MOOCs using the same signing up credentials as the researcher and shared access to the mailbox. Following a replicability approach, those components that require the use of tools (Technical Accessibility and UX) were introduced to the raters during the first meeting. The next subsections detail the validation results for each of the components. They have been structured as follows:

- **Context**. Each component validation has variations, including the sample and the evaluators.

- **Final agreement.** Statistical mathematical agreement based on evaluations using Cohen's Kappa (0.01 – 0.20 slight agreement, 0.21 – 0.40 fair agreement, 0.41 – 0.60 moderate agreement, 0.61 – 0.80 substantial agreement and 0.81 – 1.00 perfect agreement).

- **Disagreement.** Disagreements detected in the component during the evaluations.

- **Discussion.** The discussion reflects on conversations that arose from disagreements about how to improve the component. In the discussion, the notes taken by the researcher during the meetings are contextualised. Criteria have been classified following a matrix considering the final agreement to a guideline level to LA or NA.

- **Future improvements.** The list of proposed improvements that were discussed during the meetings and that have not been implemented in the current implementation.

8.3.2 Technical accessibility evaluation

For this audit component, a rater participated in evaluating FL MOOC.

Context

As Brajnik et al. (2010) claim, training is important to reduce the expertise gap on WCAG, for that reason the rater is an educational technology developer with experience in accessibility. The challenge in this component was to get a correct adaptation for the *"what to test for"* and *"testing method"* sections for MOOCs.

Final agreement

After the evaluation, there was an agreement in 56 out of 64 criteria, 41 with the perfect agreement. The Cohens Kappa is considered of substantial agreement (**Table 8.5**).

Table 8. 5. Percentage of agreement and Cohen's Kappa between evaluators

	FL (Rater 1)
Evaluators agree is a success criterion	28
Evaluators agree is a failure criterion	28
Only the researcher thinks is a success criterion	4
Only the rater thinks is a success criterion	4
Percentage of agreement	87.5%
Cohen's Kappa	0.75

The high percentage of agreement is likely to be a consequence of the evaluators' joint experience in the use of WCAG, it was also agreed that having available multiple tools for the evaluation helped. The evaluation using this component, which contains 64 criteria, was time-consuming since each proposed tool is applicable to a specific set of criteria. Note that within the perfect agreement criteria, 12 (29.26%) implied the criteria were *"not applicable"*.

Disagreement

Table 8.6 shows the disagreements, which were related to the correct application of the criteria *"images of text"* (1.4.9) and "*pronunciation"* (3.1.6) and included discussion around links which were not correctly shown using the mouse over, and headings not following the correct ordering or missing inclusion in the content.

Table 8. 6. Disagreements and final agreements

Criteria	Researcher	Rater	Final Agreement
Perceivable			
1.4.1: Use of Colour	LA	NA	PA
1.4.9: Images of Text (No Exception)	PA	FA	LA
Operable			
2.4.4: Link Purpose (In Context)	PA	LA	LA
2.4.6: Headings and Labels	PA	LA	PA
2.4.8: Location	FA	PA	PA
Understandable			
3.1.6: Pronunciation	NA	FA	NA
3.3.1: Error Identification	LA	PA	PA
Text-based files			
5.2: Logical Structure	LA	NA	PA

Of interest between the moderate agreements is the case of the audio description which the rater considered *"not applicable"* due to his lower experience using MOOCs. The rest of the moderate agreements, as shown in **Table 8.7**, tend to agree on the lower rating, lowering the compliance from FA to LA or from PA to NA.

Table 8. 7. Moderate agreements and final agreements

Criteria	Researcher	Rater 1	Final Agreement
Perceivable			
1.2.3: Audio Description or Full-Text Alternative	LA	NAP	LA
1.2.5: Audio Description	PA	NAP	PA
1.3.2: Meaningful Sequence	FA	LA	LA
Operable			
2.1.1: Keyboard	FA	LA	FA
2.1.3 Keyboard (No Exception)	FA	LA	FA
2.2.1: Timing Adjustable	FA	LA	LA
2.4.3: Focus Order	FA	LA	LA
2.4.5: Multiple Ways	FA	LA	LA
2.4.7: Focus Visible	FA	LA	LA
2.4.9: Link Purpose (Link Only)	FA	LA	LA
Understandable			
3.1.5: Reading Level	FA	LA	LA
3.2.5: Change in Request	FA	LA	LA
3.3.6: Error Prevention (All)	FA	LA	LA
Robust			
4.1.2: Name, Role, Value	PA	NA	NA
Text-based files			
5.1: Basic Requirements	PA	NA	NA

It can be observed that most discrepancies arose in the *"Operable"* principle around the use of the *"keyboard"* (2.1.1 and 2.1.3) and the adjustments for *"timing"* and *"focus"* (2.2.1, 2.4.3 and 2.4.7). Other initial disagreements included subjective to evaluate criteria such as the *"reading level"* (3.1.5).

Table 8. 8. Matrix-based on accessibility evaluation final agreements

Fully achieved	**Partially Achieved**
2.1 Keyboard Accessible - Keyboard	1.2 Time-based Media - Audio Description 1.4 Distinguishable -Use of Colour 2.4 Navigable - Headings, Labels and Location 3.3 Input Assistance - Error Identification 5 Accessible PDF - Logical Structure
Largely achieved	**Not Achieved**
1.2 Time-based Media – Full-Text Alternative 1.3 Adaptable – Meaningful Sequence 1.4 Distinguishable - Images of Text 2.2 Enough Time -Timing Adjustable 2.4 Navigable - Focus, Link Purpose, Multiple Ways 3.1 Readable - Reading Level 3.2 Predictable - Change in Request 3.3 Input Assistance - Error Prevention	3.1 Readable - Pronunciation 4.1 Compatible - Name, Role, Value 5 Accessible PDF - Basic requirements

Table 8.8 indicates final agreements occurred in all levels, with a predominance of largely and partially achieved.

Future improvements

Some of the limitations from this component to be improved in next versions are:

1. **WCAG 2.1**. Discussions raised some of the WCAG limitations. An upgrade to WCAG 2.1 is desirable for the next version of the audit.

2. **Not applicable.** Further versions should consider which *"not applicable"* criteria are excluded.

3. **W3C Accessibility Conformance Testing (ACT) Rules for Manual Web AEM.** The component is based on the test samples for WCAG 2.0. The Task Force of W3C Accessibility Guidelines Working Group (AGWG)[78] is developing ACT Rules Format 1.0, ACT Review Process and ACT Rules Repository. These rules are expected to help to test accessibility using WCAG in an exemplified way and with common examples for evaluators. The next version of the component should consider ACT rules.

4. **Text-based files.** It would be convenient to include more formats than PDF for the next evaluations, even if PDF is the most common format for text-based files in MOOCs.

8.3.3 User Experience Evaluation

For the UX evaluation two raters participated evaluating edX and FL MOOCs (in this order due to the sequence of the meetings), both raters were experts in UX component design.

[78] WAI-Tools Project, https://www.w3.org/WAI/Tools/

Context

This component is a new development using personas derived from the disabled learners' interviews and MOOC designed scenarios. In this evaluation, it was relevant to confirm personas and scenarios worked correctly together.

Final agreement

Rater 3 showed an agreement of 20 out of 23 criteria, 17 showing perfect agreement and a Cohen's Kappa with a substantial agreement. For rater 2 there was an agreement of 19 out of 23, 14 of the criteria were perfect agreement, the Cohens Kappa shows a moderate agreement (**Table 8.9**).

Table 8. 9. Percentage of agreement and Cohen's Kappa between evaluators

	edX (Rater 3)	FL (Rater 2)
Evaluators agree is a success criterion	8	16
Evaluators agree is a failure criterion	13	3
Only the researcher thinks is a success criterion	2	3
Only the rater thinks is a success criterion	1	1
Percentage of agreement	87.5%	82.6 %
Cohen's Kappa	0.74	0.49

The disparity of agreements between raters indicates the complexity and expertise needed to evaluate the new set of scenarios and personas.

Disagreement

Table 8.10 shows the disagreements and moderate agreements between the two raters and the researcher. Blank rows in the table are where perfect agreement occurred. With rater 3 the majority of disagreements had to do with the *"platform design and access"* principle, while with rater 2 they were *around "Help: Report and feedback"* and *"MOOC design"* principles. Both raters had disagreements in relation to the *"Educational resources"* principle.

Table 8. 10. Raters disagreements, moderate agreements and final agreements

Criteria	edX			FL		
	Researcher	Rater 3	Final Agreement	Researcher	Rater 2	Final Agreement
Platform design and access						
1.1 MOOC platform registration	LA	FA	LA	FA	LA	LA
1.2 MOOC platform sign in	FA	LA	LA			
1.3 Password recovery	LA	PA	PA			
2.1 MOOCs search	PA	LA	PA			
Educational resources						
3.1 Video interaction				PA	FA	LA
5.2 File interaction	NA	PA	PA	LA	FA	LA
Discussion, assignments, tests and quizzes						
7.1 Discussion interaction	LA	PA	LA			
8.2 Quiz feedback				FA	LA	LA
Help: Report and feedback						

Criteria	edX			FL		
	Researcher	Rater 3	Final Agreement	Researcher	Rater 2	Final Agreement
9.1 Help interaction				NA	PA	PA
9.2 Help contact				NA	LA	PA
MOOC design						
10.1 MOOC workload				LA	NA	PA
11.1 Week workload				LA	FA	LA
11.2 Week syllabus				PA	FA	LA

Discussion

Discussions with rater 3 focussed on use of language and improvement of the scenarios. For the "*Educational resources"* it is important to differentiate between navigable and downloadable. Reflections in the *"Discussion, assignments, tests and quizzes"* principle highlighted the complexity of evaluating P2P assignments by learners. The accessibility in each assignment needs to be considered individually, noting that providing different formats to learners and in the discussions may not be intuitive. In the *"MOOC design"* it was reported course teams tend to include excessive workload per week.

Discussions with rater 2 covered perceptions for improving *the "platform design and access", "MOOCs design"* and "*Help: Report and feedback*" principles. Learners may have difficulties in following information with factors such as the colour scheme to understand the progress, lack of consistency in the text size and notifications not being clear. The description of the week content can be repetitive and lack of structure and the term *"help"* may not be used with consistency.

Table 8. 11. Matrix-based on UX evaluation final agreements

Fully achieved	Partially achieved
	1 Registration and sign in - Password recovery 2 Search and navigation - MOOCs search 5 Educational resources - File interaction 9 Help: Report and feedback- Help interaction and contact 10 MOOC experience - MOOC workload
Largely achieved	**Not achieved**
1 Registration and sign in - MOOC platform registration and sign in 3 Video - Video interaction 7 Discussion - Discussion interaction 8 Quiz-Test - Quiz feedback 11 Week experience- Week workload and week syllabus	

Table 8.11 indicates final agreements at the guideline level were partially achieved and largely achieved.

Future improvements

Reflections with both raters during the discussions included improvements to be considered in further audit developments:

1. **Representativeness of the sample**. Future versions of the audit should include more personas, the evaluators could then choose the personas to use depending on their needs.

2. **Personas.** It is difficult to put *"yourself"* in the place of learners, particularly as some disabilities are complex, such as mental health or dyslexia. It is desirable to include more explanations and tools in future versions to reduce subjectivity when evaluating.

3. **Rating system.** Every single persona could be able to rate criteria instead of only provide comments. Generating ratings provided by the personas would help the evaluator to decide the final value.

8.3.4 Quality evaluation

For the quality evaluation, two raters have assessed Coursera (Rater 4) and Canvas (Rater 5) MOOCs. In this case two PhD research students, whose research is focused on MOOCs.

Context

For this component of the audit several versions of an existing checklist, originally designed to be used during MOOC production, have been adapted for the audit. The information adapted in the *"what to test for"* and *"testing method"* sections differ from the established checklist and so are of particular relevance to be validated.

Final agreement

As shown in **Table 8.12** with rater 4 agreement was of 45 out of 52 criteria, with 35 of full agreement. For rater 5 it was of 40 out of 52, 30 of full agreement. The Cohen's Kappa was of a moderate agreement in both cases.

Table 8. 12. Percentage of agreement and Cohen's Kappa between evaluators

	Coursera (Rater 4)	Canvas (Rater 5)
Evaluators agree is a success criterion	40	33
Evaluators agree is a failure criterion	5	7
Only the researcher thinks is a success criterion	1	1
Only the rater thinks is a success criterion	6	11
Percentage of agreement	86.5%	76.9%
Cohen's Kappa	0.51	0.41

The agreement is indicative of criteria that include very open information for the evaluations and that prior training is needed to use the checklist.

Disagreement

Table 8.13 shows all the disagreements and moderate agreements between the two raters and the researcher. Joint disagreements occurred in 6 criteria: *"educational resources"* (1.5.1), *"pace"* (2.2.2), *"levels of difficulty"* (2.5.7), *"engagement"* (2.5.10), *"plagiarism"* (2.8.2) and *"social networks"* (3.2.2).

Table 13. Raters disagreements, moderate agreements and final agreements

Criteria	Coursera			Canvas		
	Researcher	Rater 4	Final Agreement	Researcher	Rater 5	Final Agreement
The MOOC criteria						
1.2.1 Enrolment				PA	FA	PA
1.2.5 Free	NA	FA	PA			
1.4.1 Study unit				PA	NA	NA
1.5.1 Educational resource	FA	LA	LA	FA	LA	LA
1.5.2 Interactivity				FA	LA	FA
1.5.4 Certification	NA	FA	NA			
Quality of the design						
2.1.1 Various groups				FA	LA	LA
2.1.2 Prior knowledge	PA	FA	PA			
2.2.1 Schedule	FA	LA	LA			
2.2.2 Pace	LA	FA	LA	FA	LA	LA
2.3.1 Goal	LA	FA	LA			
2.4.2 Statement				FA	PA	PA
2.4.5 Prior knowledge				LA	FA	LA
2.5.6 Assignments	FA	LA	LA			
2.5.7 Levels of difficulty	LA	FA	LA	LA	PA	PA
2.5.8 Participation				FA	PA	LA
2.5.9 Learning pathways	PA	FA	PA			
2.5.10 Engagement	LA	FA	LA	FA	PA	LA
2.6.1 Range				FA	PA	LA
2.6.2 License policy	NA	FA	PA			
2.6.5 Examples				FA	PA	FA
2.7.1 Scalability				FA	PA	FA
2.7.2 Regularity				FA	PA	LA
2.7.3 Frequency				FA	PA	PA
2.7.5 Synthesis	PA	NA	PA			
2.7.6 Live events				NA	PA	NA
2.8.1 Learning goals				FA	LA	LA
2.8.2 Plagiarism	FA	NA	FA	LA	PA	LA
2.8.3 Badge	NA	PA	NA			
Technical platform and support for learners						
3.1.2 Online tools				FA	LA	LA
3.2.1 Profile	LA	FA	LA			
3.2.2 Social networks	NA	FA	PA	FA	LA	LA
3.2.6 Pedagogical guideline				FA	PA	PA

Discussion

As a consequence of the checklist being an adaptation, much of the conversations were around the correct use of the language in instructions to help evaluators and the definition of the golden items. Discussions with rater 4 included the clarity of information provided in the *"Quality of the design"* principle in the MOOC main page, prior knowledge and target groups. Discussions with rater 5 were around the same principle, including refinements on evaluating the MOOCs structure, target groups differentiation, interaction in the discussion, lack of participation of facilitators and automated feedback in quizzes.

Table 8. 13. Matrix-based on Quality evaluation final agreements

Fully achieved	**Partially achieved**
(2.4) Learning goals - prior knowledge (2.5) Learning activities – assignments (2.6) Educational resources - examples (2.7) Feedback mechanism - scalability	(1.2) Open – enrolment and free (2.1) Target group – prior knowledge (2.4) Learning goals – statement (2.5) Learning activities - levels of difficulty and learning pathways (2.6) Educational resources - license policy (2.7) Feedback mechanism – frequency and synthesis (3.2) Support for MOOC learners - social networks and pedagogical guideline
Largely achieved	**Not achieved**
(1.5) Full course - educational resource and interactivity (2.1) Target group – various groups (2.2) Workload – schedule and pace (2.3) Overall goal (2.5) Learning activities – participation and engagement (2.6) Educational resources – range (2.7) Feedback mechanism – regularity (2.8) Assessment - learning goals and plagiarism (3.1) Platform - online tools (3.2) Support for MOOC learners - profile	(1.4) Course – study unit (1.5) Full course – certification (2.7) Feedback mechanism- live events (2.8) Assessment - badge

Table 8.13 indicates final agreements were divided between the 4 achievement levels.

Future improvements

The conversations with both raters included reflection on further audit developments:

1. **Redundancy.** Redundancy of some of the criteria was apparent. This redundancy also exists in the original checklists and it was decided to keep all the criteria chosen with the expert for this implementation.

2. **Accessibility**. Further developments need to consider the relationship of some of the quality criteria with technical accessibility.

3. **Training.** Even though the selected raters were experts in MOOCs, training on understanding quality is needed.

8.3.5 Learning design evaluation

An expert in UDL has helped in this process as both an expert and a rater.

Context

For the learning design validation, the process followed was different from the other components. The checklist based on the UDL framework is a new development to make it applicable for MOOCs. The process has included three evaluations, instead of two, with two aims: improving the specifications for evaluators by allowing an additional iteration and training the researcher through the use of UDL.

In each of the meetings with the rater, the content of *"what to test for"* and *"testing method"* sections in the criteria were reviewed and improved; the updated version being used for the next evaluation. **Figure 8.1** shows the evolution of criterion 9.1 and 2.2 as examples. The language in the *"what to test for"* and *"testing method"* sections evolved from general testing to a focus on the MOOC structure.

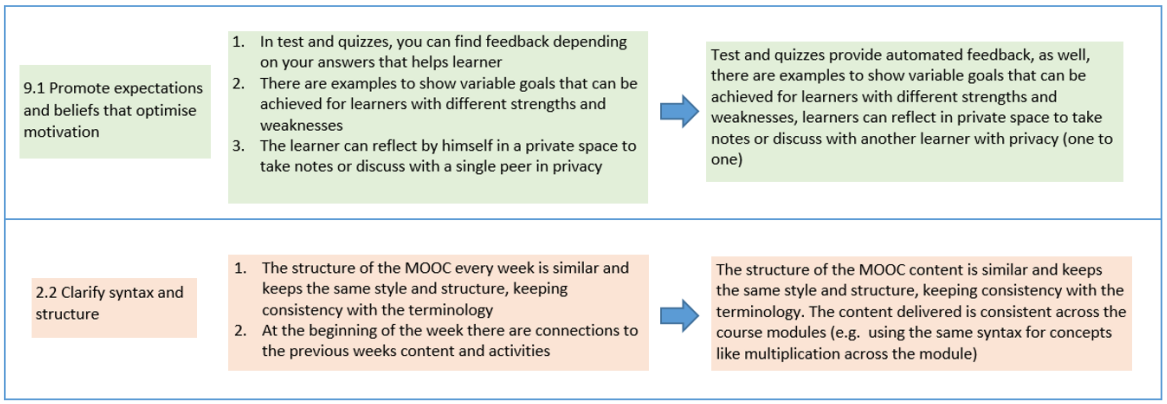

Figure 8. 1. Learning design checklists evolution

Final agreement

As shown in **Table 8.14** the edX agreement was of 24 out of 31, with 10 full agreements. With Canvas there was a consensus of 24 out of 31, 11 of full agreement. Finally, with Coursera, there was a consensus of 26 out of 31, 12 of the criteria with full agreement. In all cases, Cohen's Kappa showed a moderate agreement.

Table 8. 14. Percentage of agreement and Cohen's Kappa between evaluators

	edX (Rater 6)	Canvas (Rater 6)	Coursera (Rater 6)
Evaluators agree is a success criterion	9	9	13
Evaluators agree is a failure criterion	15	15	7
Only the researcher thinks is a success criterion	7	7	0
Only the rater thinks is a success criterion	0	0	5
Percentage of agreement	77.4%	77.44%	80%
Cohen's Kappa	0.55	0.55	0.59

The evolution indicates the level of agreement is similar in the whole process.

Disagreement

Table 8.15 shows the disagreements, moderate agreements and final agreements. Only one criterion of the 31 has not incurred any discrepancies (*"Use multiple tools for construction and composition"*, 5.2), which exemplifies the different interpretations that can be made while using UDL. Examining the table it can be seen that those criteria where there has been most discrepancy have been *"Optimise relevance, value, and*

authenticity" (7.2), *"Foster collaboration and community"* (8.3) and "*Highlight patterns, critical features, big ideas, and relationships"* (3.2). Disagreements in the principle of *"multiple means of engagement"* arose to specify the ways engagement can be improved and assessed in MOOCs. In the case of *"multiple means of representation"* disagreements were around highlighting patterns and the use of language in MOOCs.

Table 8. 15. Raters disagreements, moderate agreements and final agreements

	edX			Canvas			Coursera		
Criteria	Researcher	Rater 6	Final Agreement	Researcher	Rater 6	Final Agreement	Researcher	Rater 6	Final Agreement
Provide Multiple Means of Engagement									
7.1 Optimise individual choice and autonomy	PA	NA	NA	LA	PA	PA	PA	LA	LA
7.2 Optimise relevance, value, and authenticity	LA	PA	PA	LA	PA	PA	FA	LA	LA
7.3 Minimise threats and distractions				FA	LA	LA			
8.1 Heighten salience of goals and objectives	PA	NA	NA						
8.2 Vary demands and resources to optimise challenge							LA	FA	LA
8.3 Foster collaboration and community	LA	NA	PA	LA	PA	LA	LA	FA	LA
8.4 Increase mastery-oriented feedback				FA	LA	LA			
9.1 Promote expectations and beliefs that optimise motivation	PA	NA	PA	LA	PA	PA			
9.2 Facilitate personal coping skills and strategies	LA	NA	PA	LA	PA	PA			
9.3 Develop self-assessment and reflection	PA	NA	PA						
Provide Multiple Means of Representation									
1.1 Offer ways of customising the display of information	LA	FA	LA				PA	LA	PA
1.2 Offer alternatives for auditory information	FA	LA	LA				LA	FA	LA
1.3 Offer alternatives for visual information							LA	FA	LA
2.1 Clarify vocabulary and symbols	PA	NA	NA				LA	FA	LA
2.2 Clarify syntax and structure	FA	LA	LA				LA	FA	LA
2.3 Support decoding of text, mathematical notation, and symbols	PA	NA	NA						
2.4 Promote understanding across languages	PA	NA	PA	PA	NA	NA	FA	LA	LA
2.5 Illustrate through multiple media	NA	PA	PA				PA	LA	PA
3.1 Activate or supply background knowledge							LA	FA	LA
3.2 Highlight patterns, critical features, big ideas, and relationships	FA	PA	PA	LA	PA	PA	FA	LA	LA
3.3 Guide information processing, visualisation, and manipulation							FA	LA	LA
3.4 Maximise transfer and generalisation	FA	PA	PA	LA	PA	PA			
Provide Multiple Means of Action and Expression									
4.1 Vary the methods for response and navigation				FA	LA	LA			
4.2 Optimise access to tools and assistive technologies				FA	LA	LA	NA	LA	PA
5.1 Use multiple media for communication	LA	NA	PA				PA	NA	PA
5.3 Build fluencies with graduated levels of support for practice and performance	PA	NA	NA	LA	PA	PA			
6.1 Guide appropriate goal-setting	LA	NA	PA				PA	NA	PA
6.2 Support planning and strategy development							NA	LA	LA
6.3 Facilitate managing information and resources	PA	NA	PA	NA	PA	PA	NA	PA	PA
6.4 Enhance capacity for monitoring progress	PA	NA	PA						

Discussion

Discussions included reflections on what to evaluate using the UDL framework. In that sense, the difficulty was of distinguishing whether the requirements are at platform or course level (e.g. there are criteria that potentially could be realisable, since the platform allows it, but they have not been included in the MOOC design). The decision was to consider those criteria as not achieved (NA).

Other discussions to improve the criteria noted the lack of specification of MOOC completion, the inclusion of discussions in educational resources, links to the learning goals in quizzes, the need of space for learners to set their own goals, and the lack of options to optimise individual choice and ways of customising the display of information.

Table 8. 16. Matrix-based on learning design evaluation final agreements

Fully achieved	**Partially achieved**
	(7) Recruiting interest - Optimise relevance, value, and authenticity (8) Sustaining effort and persistence - Foster collaboration and community (9) Self-regulation - Promote expectations and beliefs that optimise motivation, facilitate personal coping skills and strategies and develop self-assessment and reflection (1) Perception - Offer ways of customising the display of information (2) Language and symbols - Illustrate through multiple media (3) Comprehension - Highlight patterns, critical features, big ideas, and relationships and maximise transfer and generalisation (4) Physical action - Optimise access to tools and assistive technologies (5) Expression and communication - Use multiple media for communication (6) Executive functions - Guide appropriate goal-setting, facilitate managing information and resources and enhance capacity for monitoring progress
Largely achieved	**Not achieved**
(7) Recruiting interest - Minimise threats and distractions (8) Sustaining effort and persistence - Vary demands and resources to optimise challenge and increase mastery-oriented feedback (1) Perception - Offer alternatives for auditory information and offer alternatives for visual information (2) Language and symbols - Clarify syntax and structure (3) Comprehension - Activate or supply background knowledge and guide information processing, visualisation, and manipulation (4) Physical action - Vary the methods for response and navigation (6) Executive functions - Support planning and strategy development	(7) Recruiting interest - Optimise individual choice and autonomy (8) Effort and persistence - Heighten salience of goals and objectives (2) Language and symbols - Clarify vocabulary and symbols, support decoding of text, mathematical notation, and symbols and promote understanding across languages (5) Expression and communication - Build fluencies with graduated levels of support for practice and performance

Table 8.26 shows final agreements were at the largely, partially and not achieved levels.

Future improvements

The main improvement for this component of the audit includes:

1. **Complexity**. Criteria are rich covering different aspects, which makes it difficult for the evaluator to decide a final rating. During the meetings, a suggestion was to add another level of depth to the evaluation, which would further increase complexity.

2. **Refinement**. There is scope for improvement and refinement of the criteria instructions and inclusion of golden items.

8.4 The implementation of the audit

In this section, the data analysis and the research findings of the audit implementation are discussed.

8.4.1 Data analysis

The data analysis for the audit implementation considers how to expose the research findings with the aim to offer objective information about accessibility barriers. The implementation includes a sample with four MOOCs from four different platform providers, which implies an added difficulty to show data from a comparative perspective. The objective is not to show which provider is better, but to detect accessibility barriers; therefore providers names are shown in the tables but only included in the discussion when it is appropriate to differentiate between different approaches.

A common structure is defined for each of the components to help to explain the main research findings:

1. **Clustering level.** Findings are divided by principles and discussions are grouped by guidelines and criteria.

2. **Order.**

    1. **Not applicable.** Compare the *"not applicable"* criteria between the sample (NAP)

    2. **Success**. Compare the success criteria between the sample (FA and LA)

    3. **Failure**. Compare the failure criteria between the sample (PA and NA)

    4. **Different.** Compare those criteria that differ between the sample (for example when a provider is successful in one criterion (FA or PA) but shows failures (PA or NA) for any other)

3. **Results achievement level.** Graphically visualise the main findings by principle to summarise.

Following this structure, it is possible to cluster the criteria where providers are doing better, worse and different. The results used in the research findings are the final agreements from the validation process, reported above. Using the agreements from the validation process means 50% of the sample evaluations have been agreed upon two evaluators. That is a higher proportion than between 10% and 15%, supported by the literature (Strijbos et al., 2006; Strijbos & Stahl, 2007).

Principles definitions are available in **Sections 7.3.2-7.3.5**, guidelines definitions are available in **Appendix 11**, while criteria are specified in **Appendices 12 to 16**. Full information about the personas for the UX evaluation is available in **Appendix 14**.

8.4.2 Accessibility information by platform providers

As shown in **Table 8.17**, at the time of collecting the data only edX offered public accessibility policies information to its course providers. From the interviews in Study A, it is known that FL also offers this information once the course providers become partners and have access to the FLAN website. For the rest of the platform providers, it was unknown what kind of private accessibility information they offer to their course providers.

Table 8. 17. Accessibility information made available by MOOC providers

	Public accessibility policies for course providers in the website	Public accessibility statement for learners in the website	Accessibility help contact in the website
Coursera	• NO	✓ YES	✓ YES
edX	✓ YES	✓ YES	✓ YES
XuetangX	• NO	• NO	• NO
Udacity	• NO	• NO	• NO
Udemy	• NO	• NO	• NO
Canvas	• NO	✓ YES	• NO
Stanford Online - Lagunita	• NO	• NO	✓ YES
Khan Academy	• NO	• NO	• NO
NovoEd	• NO	✓ YES	• NO
FL	• NO	✓ YES	• NO
NPTEL	• NO	• NO	• NO
UNINETTUNO	• NO	• NO	• NO
Open2Study	• NO	✓ YES	• NO
Iversity	• NO	• NO	• NO
FUN	• NO	• NO	• NO
Miríada X	• NO	• NO	• NO
UNED Abierta	• NO	• NO	• NO
Telescopio	• NO	• NO	• NO
Uab iMOOC UAB	• NO	• NO	• NO
ECO eLearning	• NO	✓ YES	• NO
Percentage reporting YES	**5% (1)**	**35% (7)**	**15% (3)**

35% of providers (Coursera, edX, Canvas, NovoEd, FL, Open2Study and ECO eLearning) included public information about the accessibility of their platform, their commitment to accessibility and, in some cases, their limitations. For example, Canvas offered a detailed accessibility report related to its engine, Canvas VLE, *"Canvas Voluntary Product Accessibility Template"* [79] which shows the level of compliance with the WCAG guidelines at its AA level.

Those platforms that included a contact (email) or specific form to report an accessibility barrier were Coursera, edX and Stanford Online. The table shows percentages were low in the three aspects of accessibility information.

[79] Canvas Voluntary Product Accessibility Template (VPAT) https://www.canvaslms.com/accessibility

8.4.3 Technical accessibility evaluation

The technical accessibility evaluation is divided into the four principles regarding web content (WCAG) and a principle added to evaluate text-based files.

Perceivable

The *"time-based media"* criteria (1.2.4 and 1.2.9) were not applicable as there were no live broadcasts in the proposed MOOCs (though there could be in others). The criteria for *"sensory characteristics" (*1.3.3), "*audio control"* (1.4.2) or *"background audio"* (1.4.7) are also not applicable and it is rare to have instructions that rely on sounds and audio that plays automatically in MOOC although there could be cases of recordings with background noise (**Table 8.18**).

Table 8. 18. Not applicable criteria for perceivable principle

Criteria	FL	Coursera	edX	Canvas
1.2.4: Captions (Live)	NAP	NAP	NAP	NAP
1.2.9 Audio-only (Live)	NAP	NAP	NAP	NAP
1.3.3: Sensory Characteristics	NAP	NAP	NAP	NAP
1.4.2: Audio Control	NAP	NAP	NAP	NAP
1.4.7: Low or No Background audio	NAP	NAP	NAP	NAP

Criteria were applied successfully to the alternatives for *"time-based media"* (1.2.1 and 1.2.2). Three providers had transcripts, while one was less explicit providing interactive PDF as an alternative. Transcripts could be downloaded in a text-based file or be read beside or below the video. In two providers the cursor marked the text at the same time as the speech. The subtitles were accurate and synchronised, one provider included them in different languages (**Figure 8.2**).

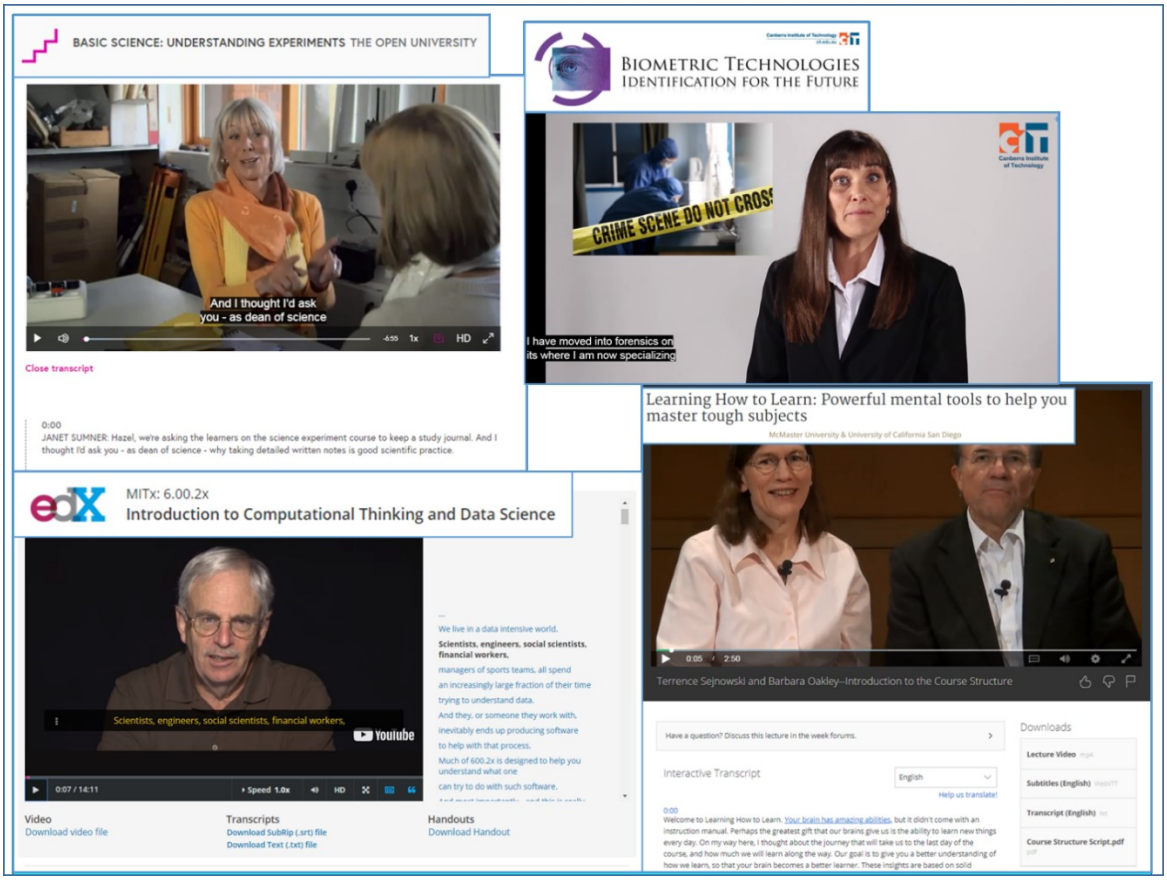

Figure 8. 2. Use of transcripts and subtitles in the sample

In general, there was a *"meaningful sequence"* with the use of CSS styles (1.3.2). For the use of *"images of text"* (1.4.5 and 1.4.9), a small number of images in two providers included duplicated information (**Table 8.19**).

Table 8. 19. Success criteria for perceivable principle

Criteria	FL	Coursera	edX	Canvas
1.2.1: Audio-only and Video-only (Pre-recorded)	FA	FA	FA	LA
1.2.2: Captions (Pre-recorded)	FA	FA	FA	FA
1.3.2: Meaningful Sequence	FA	FA	FA	LA
1.4.5: Images of Text	LA	FA	FA	LA
1.4.9: Images of Text (No Exception)	LA	FA	FA	LA

For the text alternatives, in the case of the *"non-text content"* (1.1.1), there was scope for improvement in providing alternative descriptions in the images; the text provided was not always accurate or redundant alternative text which did not meet the objective to explain the content. None of the providers included *"sign language"* interpretation (1.2.6). All providers included empty headings, form controls without an associated label and headers of the same level with no content in between (*"Info and relationships"*, 1.31). All providers had instances of low *"contrasts"* for normal and large text (1.4.3 and 1.4.6) (**Table 8.20**).

Table 8. 20. Failure criteria for perceivable principle

Criteria	FL	Coursera	edX	Canvas
1.1.1: Non-text Content	PA	NA	PA	NA
1.2.5: Audio Description	PA	NA	NA	NA
1.2.6: Sign Language	NA	NA	NA	NA
1.3.1: Info and Relationships	NA	NA	NA	NA
1.4.3: Contrast (Minimum)	NA	NA	NA	NA
1.4.6: Contrast (Enhanced)	NA	NA	NA	NA

One provider included *"audio description or full-text alternative"* (1.2.3), for the rest, videos relied on visual information, including labelled presentations, providers included handouts and interactive PDFs to mitigate. *"Extended audio description"* (1.2.7) was not needed in most cases, in one provider there was visual information in the presentations that could benefit from its use. The *"media alternative"* (1.2.8) was not working for the one provider that does not supply transcripts. In general, *"colour"* was not used to communicate information (1.4.1). Two providers failed to *"resize text"* (1.4.4) or change the *"visual presentation"* (1.4.8) (**Table 8.21**).

Table 8. 21. Different criteria for perceivable principle

Criteria	FL	Coursera	edX	Canvas
1.2.3: Audio Description or Full-Text Alternative	LA	PA	PA	PA
1.2.7 Extended Audio Description	NAP	NAP	NA	NAP
1.2.8 Media Alternative	FA	FA	FA	NA
1.4.1: Use of Colour	PA	FA	FA	FA
1.4.4: Resize text	FA	PA	FA	PA
1.4.8: Visual Presentation	LA	PA	LA	PA

In **Figure 8.3** when looking at the general levels of the *"perceivable"* principle, a noticeable aspect is the large number of criteria that were *"not applicable"*. In some cases, the criteria were not applicable because they are not common practices in MOOCs, in other cases because the pedagogical approach chosen did not include their use. For the ***"perceivable"*** principle providers achieved basic requirements of audio and video but were having problems with audio description, sign language and media alternative, and with the use of colour, contrast and visual presentation.

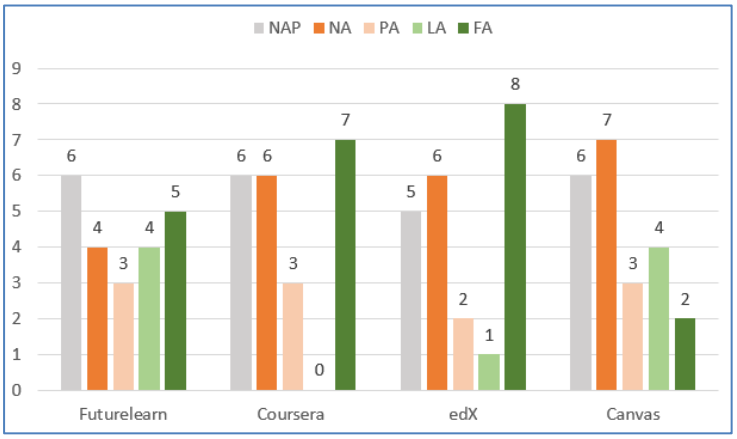

Figure 8. 3. Perceivable principle achievement level

Operable

In this principle some criteria were *"not applicable"* in all the providers, there was no *"moving"* (2.2.2) and no *"flashing"* content (2.3.1 and 2.3.2) (**Table 8.22**).

Table 8. 22. Not applicable criteria for operable principle

Criteria	FL	Coursera	edX	Canvas
2.2.2: Pause, Stop, Hide	NAP	NAP	NAP	NAP
2.3.1: Three Flashes or Below Threshold	NAP	NAP	NAP	NAP
2.3.2: Three Flashes	NAP	NAP	NAP	NAP

For the *"keyboard accessible"* guideline (2.1) the keyboard access worked in all providers. In general *"timing is adjustable"* (2.2.1) with some exceptions:

- FL did not log out unless the page is left.
- In Coursera quizzes were available for 24 hours within which learners could retake them as many times as they wish.
- In edX tests had a time limit of 8 hours, the login could be extended by learners selecting the *"keep me logged"* option.
- In Canvas quizzes were timed but timing could be switched off.

Learners could continue activity without loss of data after *"re-authenticating"* (2.2.5). For the *"navigation"* guideline (2.4) pages had unique and descriptive titles, focusable items followed a logical sequence, and content could be found via a *"search function"* or a *"sitemap"* (**Table 8.23**).

Table 8. 23. Success criteria for operable principle

Criteria	FL	Coursera	edX	Canvas
2.1.1: Keyboard	FA	FA	FA	FA
2.1.2: No Keyboard Trap	FA	LA	FA	FA

Criteria	FL	Coursera	edX	Canvas
2.1.3 Keyboard (No Exception)	FA	FA	FA	FA
2.2.1: Timing Adjustable	LA	FA	LA	FA
2.2.5: Re-authenticating	LA	FA	FA	LA
2.4.2: Page Titled	FA	FA	FA	FA
2.4.3: Focus Order	FA	FA	FA	FA
2.4.5: Multiple Ways	FA	FA	FA	FA
2.4.7: Focus Visible	LA	LA	LA	FA

"No timing" criterion (2.2.3) was not applicable to one provider since it did not provide free access to the tests, in one provider timing could not be switched off. Two providers did not offer automatic updates (*"Interruptions*", 2.2.4), while for the rest these could be configured. In terms of *"headings and labels"* (2.4.6), one platform had several missing headings and label names. Two providers offered a *"skip main navigation"* (2.4.1). Two providers included *"links"* with the same description but different destinations (2.4.9). Only one provider consistently followed the correct document structure (2.4.10) (**Table 8.24**).

Table 8. 24. Different criteria for operable principle

Criteria	FL	Coursera	edX	Canvas
2.2.3: No Timing	NAP	FA	NA	FA
2.2.4: Interruptions	NAP	FA	NAP	FA
2.4.1: Bypass Blocks	FA	NA	FA	NA
2.4.4: Link Purpose (In Context)	PA	FA	PA	NA
2.4.6: Headings and Labels	PA	FA	FA	FA
2.4.8: Location	PA	FA	FA	FA
2.4.9: Link Purpose (Link Only)	FA	PA	FA	NA
2.4.10: Section Headings	PA	NA	FA	NA

Figure 8.4 shows the *"operable"* principle was achieved overall by the four providers. This principle was achieved in the use of the keyboard, having adjustable timings, the re-authentication, the focus order and visibility. The main failures were related to link destinations and descriptions and the use of headings and labels.

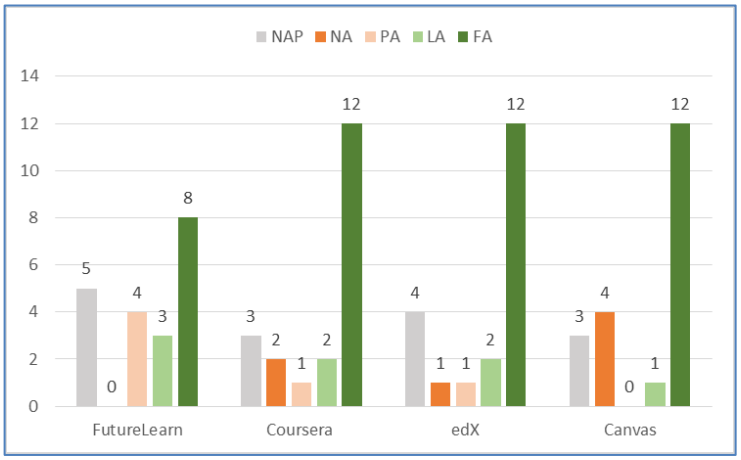

Figure 8. 4. Operable principle achievement level

Understandable

In relation to the *"understandable"* principle, MOOCs did not include the submission of legal or financial information (3.3.4) although this could include payments, for example, for the purchase of a certificate, this option was not evaluated in the audit implementation. Text provided in all MOOCs was comprehensible with short sentences and written clear and simple (3.1.5). In terms of the *"predictability"* guideline (3.2) no changes in context or focus happened without being initiated by the learner, navigation was consistent, text alternatives and components were labelled consistently across pages (**Table 8.25**).

Table 8. 25. Not applicable and success criteria for understandable principle

Criteria	FL	Coursera	edX	Canvas
3.3.4: Error Prevention (Legal, Financial, Data)	NAP	NAP	NAP	NAP
3.1.5: Reading Level	LA	LA	FA	FA
3.2.1: On Focus	FA	FA	FA	FA
3.2.2: On Input	FA	FA	FA	FA
3.2.3: Consistent Navigation	FA	FA	FA	FA
3.2.4: Consistent Identification	FA	FA	FA	FA
3.2.5: Change in Request	LA	FA	FA	FA

MOOCs in the sample did not provide a glossary of *"unusual words"* (3.1.3) or *"abbreviations"* (3.1.4) or help with the *"pronunciation"* (3.1.6). No *"error suggestions"* (3.3.3) were provided in forms (e.g. in the registration and sign in only one provider offers brief information for incorrect email formatting). There was also a lack of context-sensitive *"help"* to provide information related to the function currently being performed (3.3.5) (**Table 8.26**).

Table 8. 26. Failure criteria for understandable principle

Criteria	FL	Coursera	edX	Canvas
3.1.3: Unusual Words	NA	NA	NA	NA
3.1.4: Abbreviations	NA	NA	NA	NA
3.1.6: Pronunciation	NA	NA	NA	NA

Criteria	FL	Coursera	edX	Canvas
3.3.3: Error Suggestion	NA	PA	NA	NA
3.3.5: Help	NA	NA	NA	NA

In terms of the *"language of the page"* (3.1.1), two providers automatically updated with the different language versions included in those platforms. *"The language of the parts"* (3.1.2) is not applicable in two providers since they were only available in English, while the others did not update all the sections when language was changed. In input assistance, for the *"error identification"* (3.3.1), in all the cases forms in the quizzes were returned with error descriptions, though two providers did not include error identification in the registration and sign in pages, the same two providers provided descriptive information in the *"labels"* (3.3.2). For *"error prevention"* (3.3.6) different approaches were taken (**Table 8.27**):

- FL gave options to update the answers.
- In Coursera it was not possible to check or confirm possible errors.
- In edX it was possible to submit the quiz without having filled in all the information.
- Canvas provided a message to inform the learner about empty fields in quizzes.

Table 8. 27. Different criteria for understandable principle

Criteria	FL	Coursera	edX	Canvas
3.1.1: Language Page	FA	FA	FA	NA
3.1.2: Language of Parts	NAP	PA	PA	NAP
3.3.1: Error Identification	PA	LA	LA	PA
3.3.2: Labels or Instructions	LA	PA	PA	FA
3.3.6: Error Prevention (All)	LA	PA	NA	LA

In the *"understandable"* principle as it can be seen in **Figure 8.5** there was a polarisation between "*fully achieved"* and *"not achieved"*. Successes were the reading levels, input events and the consistency of navigation and identification. Failures included the lack of dictionaries and error suggestion when filling in online forms. Different situations occurred for the provided in the quizzes and test with error identification and the use of labels. The use of multiple languages was better achieved in those providers which offer multilingual platforms.

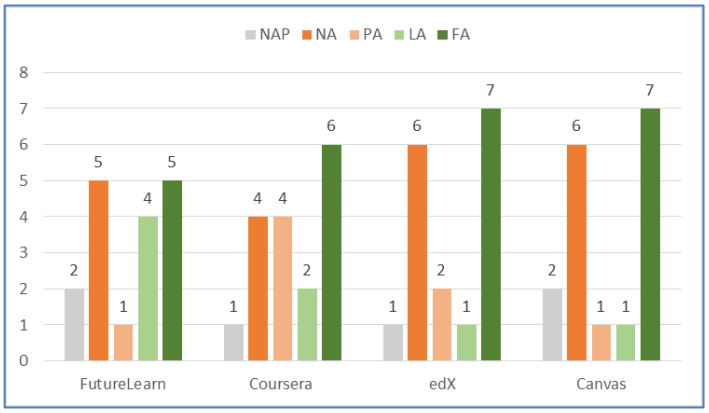

Figure 8. 5. Understandable principle achievement level

Robust

"Robust" principle was not followed by any provider (4.1), for every provider there were errors in how well-formed the pages well-formedness and form controls without a label (**Table 8.28**).

Table 8. 28. Failure criteria for the understandable principle

Criteria	FL	Coursera	edX	Canvas
4.1.1: Parsing	NA	NA	NA	NA
4.1.2: Name, Role, Value	NA	NA	NA	NA

Text-based files

The sample for this evaluation included MOOCs with self-produced PDFs and in some cases guidelines about technical and pedagogical indications in PDF format were produced by the platform provider (**Table 8.29**).

Table 8. 29. Sample specification for the PDF files

	MOOC Self-produced	**Platform provider produced**
FL	Basic Science: Understanding Experiments. Activity booklet	The crowdsourced guide to learning
Coursera	Using the focused and diffuse modes	*Not available*
edX	Optimization Problems, Lecture 1, Segment 1	edX syllabus
Canvas	W1 Topic 1 Interactive Transcript	*Not available*

PDFs had problems in meeting the *"basic requirements"* (5.1) criteria in the use of natural language, although two providers complied with the use of fonts. In terms of *"logical structure"* three providers failed in providing alternative descriptions. There were problems in all providers with the *"metadata and settings"* (5.2) of the PDFs (**Table 8.30**).

Table 8. 30. Failure and different criteria for the PDF files

Criteria	**FL**	**Coursera**	**edX**	**Canvas**
5.1 Basic Requirements	NA	PA	NA	PA
5.2 Logical Structure	NA	LA	PA	PA
5.3 Metadata and Settings	PA	PA	NA	NA

The text-based files results were poor with ratings of *"not achieved"* and *"partially achieved"*.

8.4.4 User Experience Evaluation

UX evaluation is divided into five principles that are matched to the MOOC structure (**Section 2.5**) and used to design the walkthroughs. The findings of the UX evaluation are explained giving special value to the comments. As explained in the audit design (**Section 7.3.3**) the approach used is that the personas can act as a simulated focus group so that the richness of the evaluation is increased with the comments provided by the personas. Several examples can be seen in **Figure 8.6** using examples across several different areas of the evaluation of FL.

2.1 MOOCs search	Try to find MOOCs that are going to start soon, on a topic you might be interested in, modifying the search settings	☐	☒	☐	☐
Matthew: MOOCs are classified by thematic area, you can browse all courses, search by category and start date, there is not a search button, it just changes the search automatically *Martha: There are options at the beginning which is good, otherwise I need to scroll down a lot getting tired. The screen readers needs time to reach the searching area* *Deborah: There are many options, categories, courses, programs and degrees, does not seem clear to me* *Rebecca: I am used to this search way, it is pretty common in all websites I can try to find what I like following a category*					
9.1 Help interaction	Try to find information around to contact for help	☒	☐	☐	☐
Matthew: There is a button for support, I do not like it does not seem to be sending any information to the teacher, seems for technical staff *Martha: I am not able to find the help, support is the most similar one and it is at the far end of the page* *Deborah: there is a support button but I am not sure whom I am asking to* *Rebecca: I can try to write for help in the discussions but they are about something else*					
10.1 MOOC workload	Consider if the work that has to be achieved is consistent with the number of hours dedicated to the MOOC	☐	☐	☒	☐
Matthew: The main page provides useful information like the availability of it, and next runs, what I will achieve, who is the course, for and who I will learn with, all the content of the MOOC is available from the beginning so I can advance if I feel like, if not, I can complete the tasks afterwards *Martha: the information about the MOOC at the beginning is rich, I miss some space where I can plan and see all the work that I need to invest during the four weeks* *Deborah: If I miss one week due to my familiar situation I can come back to it cause all the content of the MOOC is open* *Rebecca: there is lot of general information about the MOOC*					

Figure 8. 6. Examples of persona comments in the UX evaluation

Platform design and access

For the MOOC *"selection"* and *"registration"* (2.2 and 2.3) all the providers achieve success levels. Information in the MOOC main page was clear and information about the course and what to learn was compact, rich in content and readable. In two providers the information about the availability of transcripts and subtitles was available to be known before the registration. For the registration, all the providers had a button to enrol in the MOOC (**Table 8.31**).

The MOOC *"search"* (2.1) shows failure achievement levels, with each provider offering different options:

- FL did not include a search button and learners need to scroll down to see all the MOOCs, adding complexity to screen readers.

- Coursera allowed filtering by categories and search by the name, suggestions show up while typing in the search, however all the paid courses appear first. Learners were forced to select the topic to include more filtering options in order to find courses offered for free.

- In edX, learners needed to go through popular MOOCs and try to find the topic they wanted by the letter it starts with. There was a free search on the top however that operates for the full site, with free MOOCs appeared in the last position of the search results.

- In Canvas the free search box did not offer suggestions while typing and learners needed to scroll down to see available courses. MOOCs were shown in a table structure with only four MOOCs per page, having to navigate through several pages.

Table 8. 31. Success and failure criteria for platform design and access

Criteria	FL	Coursera	edX	Canvas
2.2 MOOC selection	FA	LA	FA	LA
2.3 MOOC registration	FA	LA	FA	LA
2.1 MOOCs search	NA	PA	PA	NA

In terms of the *"Registration and sign in"* guideline (1.1 and 1.2), sessions remained open unless the browser closed. Providers also followed the same policy that if learners forget their password (1.3) they have to reset it using the email provided during registration. Three of the providers offered the possibility to sign up using social media (**Figure 8.7**).

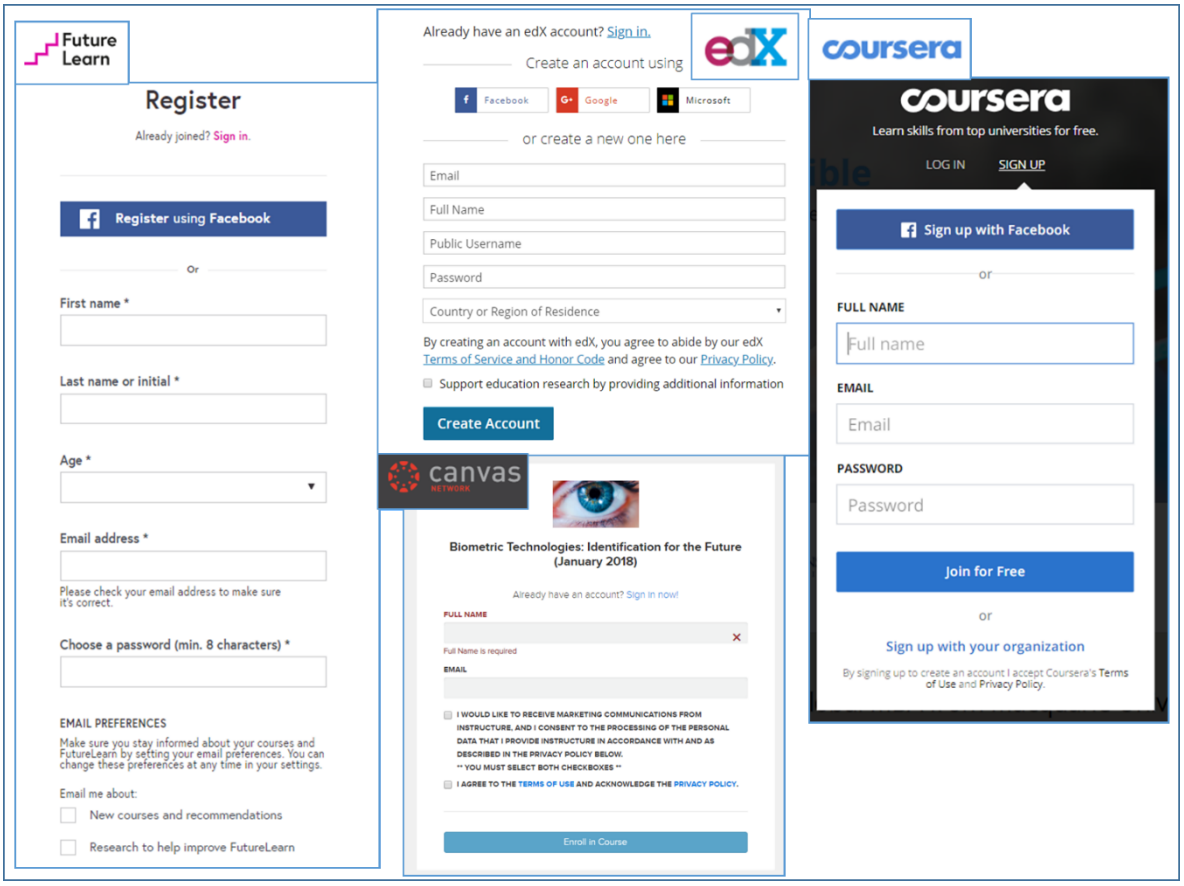

Figure 8. 7. Registration pages in the sample

One of the providers asked for more information during the registration process than the other providers (e.g. country of residence) which not all learners may feel comfortable to fill in, while another provider had a very complex system for enrolment; learners needed to sign up for a course and then ask to be enrolled, only after that was the account created (**Table 8.32**).

Table 8. 32. Different criteria for platform design and access

Criteria	FL	Coursera	edX	Canvas
1.1 MOOC platform registration	LA	FA	LA	NA
1.2 MOOC platform sign in	FA	FA	LA	PA
1.3 Password recovery	LA	PA	PA	PA

In terms of the *"platform design and access,"* principle the registration and sign-in processes were standard but differently achieved between providers, the MOOC search process was poorly designed in all cases (**Figure 8.8**).

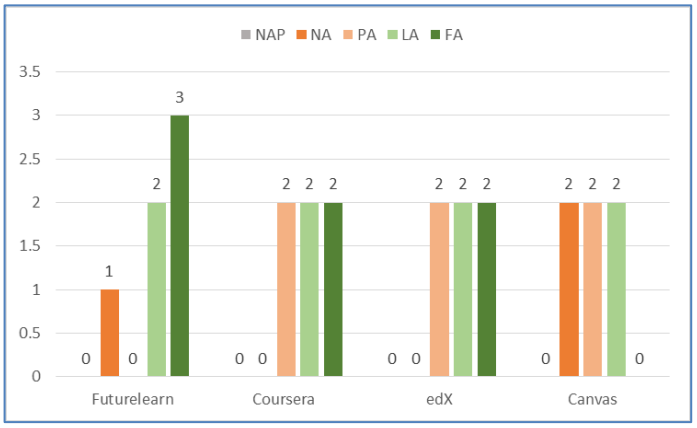

Figure 8. 8. Platform design and access achievement level

Educational resources

In all the MOOCs the video could be stopped at any moment, in two providers the platform remembered where learners stopped watching a video and continued from the same video frame (*"Video interaction"*, 3.1). One provider offered information about the length of the videos beforehand and whether they included subtitles and if transcripts were available in different languages.

The three providers that used transcripts each allowed them to be visible when playing the video on the screen, and for two providers the spoken phrases were highlighted while the video played. In one provider the transcripts were to the right of the video, enabling the learner to both see the video and read the transcripts dynamically. For the other two providers, transcripts were played beneath the video and learners needed to scroll down losing the video visibility. In the provider that did not offer transcripts videos opened in a different tab using PlayPosit[80] technology, while this allowed enhanced video that includes interactivity within it, subtitles appeared on the left margin making readability difficult (**Figure 8.9**).

Two providers included *"only text"* educational resources (4.1). In one of them, the information was in general simple and clear to the reader, although fonts were big and so required scrolling down. Text-based files were easy to download (5.1), though in one case the documents were downloaded in a compressed file

[80] PlayPosit, https://learn.playposit.com/learn/

(ZIP) which not all learners may know how to use. Text-based files did not offer choice of font size, alternative text or use of formulas (5.2). Alternative formats (e.g. Word) could have been more convenient for reusability purposes in assignments. For the providers that included handouts these were not always linked to the video content. Interactive PDFs included questions allowing participation, but they can stop working. Results against these criteria are summarised in **Table 8.33**.

Table 8. 33. Different criteria for educational resources

Criteria	FL	Coursera	edX	Canvas
3.1 Video interaction	LA	LA	LA	PA
4.1 Article interaction	LA	PA	NAP	NAP
5.1 File download	FA	LA	PA	LA
5.2 File interaction	LA	NA	PA	PA

For the *"Educational resources"* principle video interaction was better developed than the use of text-based files (**Figure 8.9**).

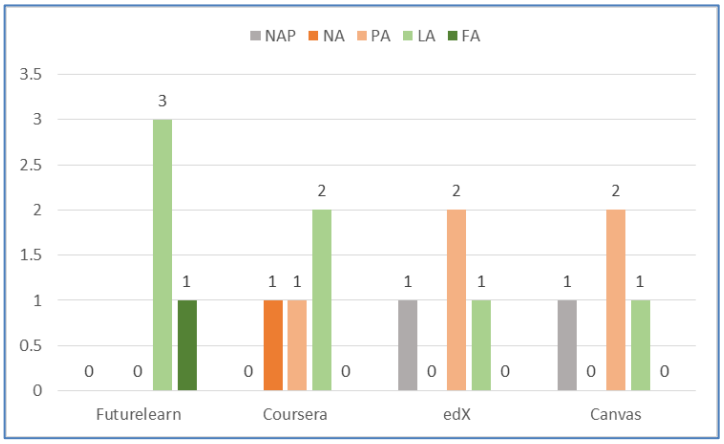

Figure 8. 9.Educational resources achievement level

Discussion, assignments, tests and quizzes

In the case of the *"assignments"* (6.2) in one provider, they were designed to be discussed in the forum available linked to each educational resource. Two other providers supported carrying out assignments online with learners able to save the answer and edit it later, avoiding the need to attach text-based file

"Discussions" (7.1 and 7.2) followed differentiated patterns in the four platforms (**Figure 8.10**):

- FL had a very linear discussion design which would require considerable scrolling to read every comment.
- Coursera included general forums and one for each week. They were structured to follow the topic and it was possible to select notifications to follow discussions and learners.

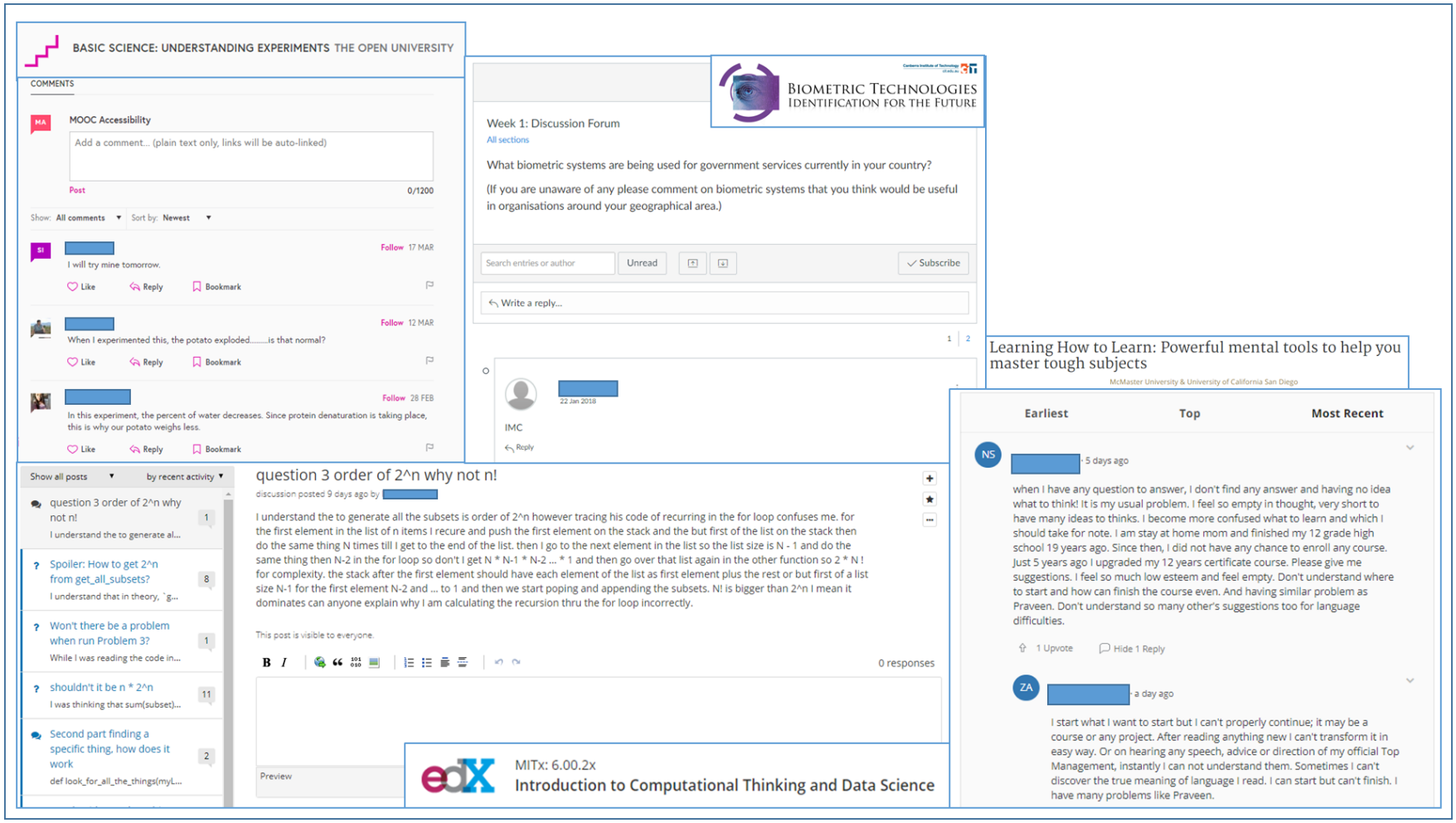

Figure 8. 10. Discussion structures in the four platforms

- edX organised the discussions differentiating between *"read"*, *"unanswered"* posts and *"votes"* received. By default, there were many discussions open which can overwhelm learners. Learners could add images and alternative text in comments.

- In Canvas' forums, it was easy to move between comments. Added comments could include images, links to online videos, formulas and alternative text.

Table 8. 34. Success criteria for discussion, assignments, tests and quizzes

Criteria	FL	Coursera	edX	Canvas
6.2 Assignment achievement	FA	FA	LA	LA
7.1 Discussion interaction	LA	LA	LA	FA
7.2 Discussion adding comments	FA	LA	FA	FA

For the *"assignment instructions"* (6.1) and *"assignment evaluation"* (6.3) providers again followed different approaches (**Table 8.35**):

- Instructions in FL were clear, though learners needed to scroll down to read them and to access the discussion. The discussion is also used to provide feedback.

- The Coursera instructions highlighted relevant words in bold, used plain language and were organised as bullet points. Instructions also offered examples for self-reflection. This provider gave instructions on how to review the work of others, encouraging learners to provide positive feedback. Assignments were optional.

- edX did not provide clear instructions. Instructions for evaluating other peers were only at the beginning of the MOOC and assignments were compulsory.

- Canvas placed focused discussions, though instructions to provide feedback were not clear.

In terms of the quiz *"interaction"* and *"feedback"* (8.1 and 8.2) (**Figure 8.11**):

- FL had quizzes with ordered questions while allowing learners to move around. The quizzes were accessible with the screen reader and feedback was provided at each question.

- Coursera provided one question each time with an associated image. Quizzes had to be taken in the provided order with no time limit. Feedback was provided for correct and incorrect answers.

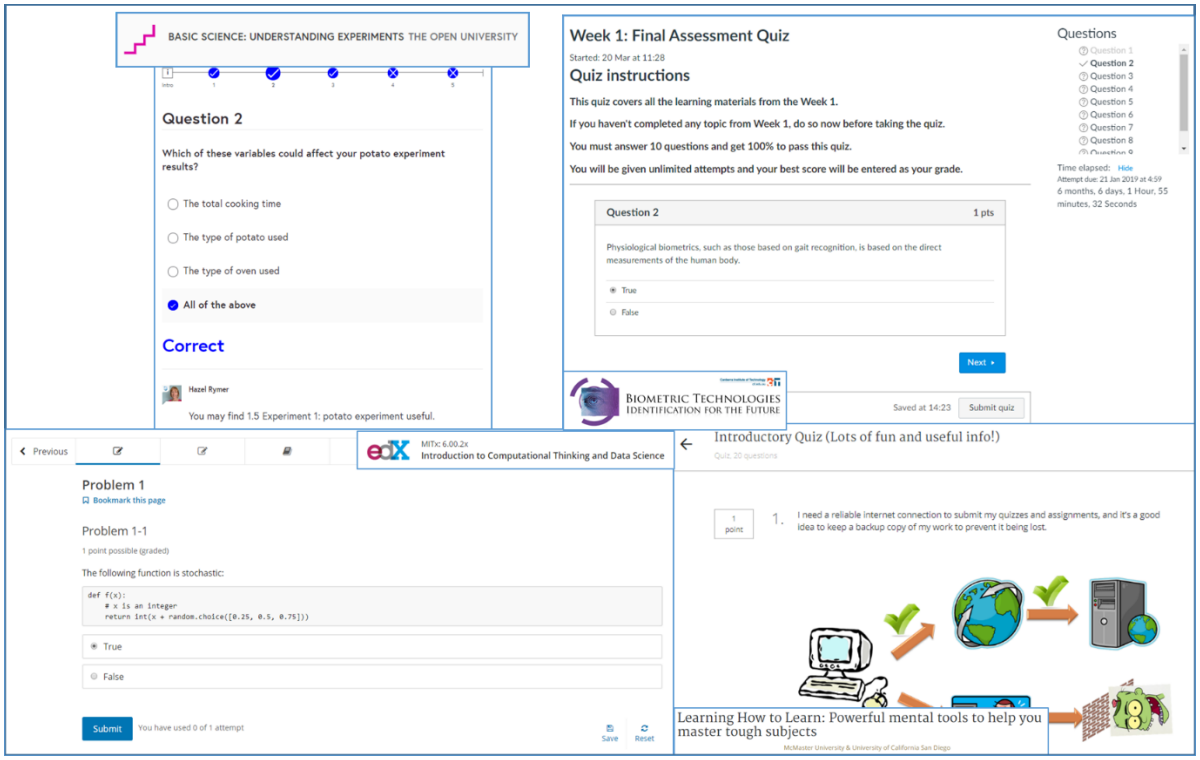

Figure 8. 11. Quiz structures in the four MOOCs

- In edX questions had a unique order and all appeared on the same screen, so learners needed to scroll down. Answers could be reset but not saved.

- Canvas followed a similar approach with no time limit and unlimited attempts, quizzes had an indicative deadline however access remained open. Learners needed to move sequentially through the questions. The platform provided a timer which can be hidden. Learners received an email confirming result. Feedback was provided for incorrect answers, though not for multiple solution questions.

Table 8. 35. Different criteria for discussion, assignments, tests and quizzes

Criteria	FL	Coursera	edX	Canvas
6.1 Assignment instructions	LA	FA	PA	LA
6.3 Assignment evaluation	FA	LA	PA	PA
8.1 Quiz interaction	FA	LA	PA	LA
8.2 Quiz feedback	LA	LA	PA	PA

In the *"discussions, assignments, tests and quizzes"* principle while discussions allowed participation, assignments and quizzes showed some problems in instructions and feedback (**Figure 8.12**).

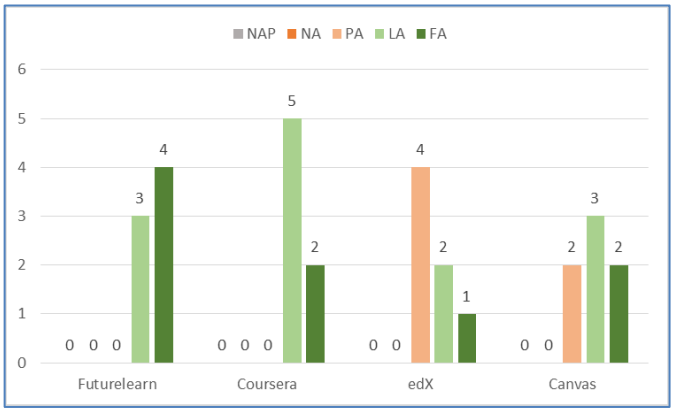

Figure 8. 12. Discussion, assignments, tests and quizzes achievement level

Help: Report and feedback

When looking for *"help"* (9.1 and 9.2), there is scope for improvement in all providers. Only one provider included a help button to contact the course team, offered a technical help forum and Q&A embedded in the MOOC. Another provider offered a support button oriented to technical issues and there was no dedicated space to ask for help in the discussion area. The two other providers included a help button which redirects learners to the help centre and general FAQs.

Table 8. 36. Failure and different criteria for Help: Report and feedback

Criteria	FL	Coursera	edX	Canvas
9.1 Help interaction	PA	NA	NA	FA
9.2 Help contact	PA	NA	NA	FA

MOOC design

In the *"MOOC design"* (10 and 11) each provider offered different approaches (**Table 8.37 and Figure 8.13**):

- FL MOOC main page provided information including the MOOC current availability and the next scheduled runs, what learners are expected to learn and suitable target groups, and the workload at week level was consistent. All the content of the MOOC was available from the beginning, which means learners can advance at their own pace using the *"mark as completed"* tool helped learners to track their progress. There were no spaces for discussion at MOOC level.

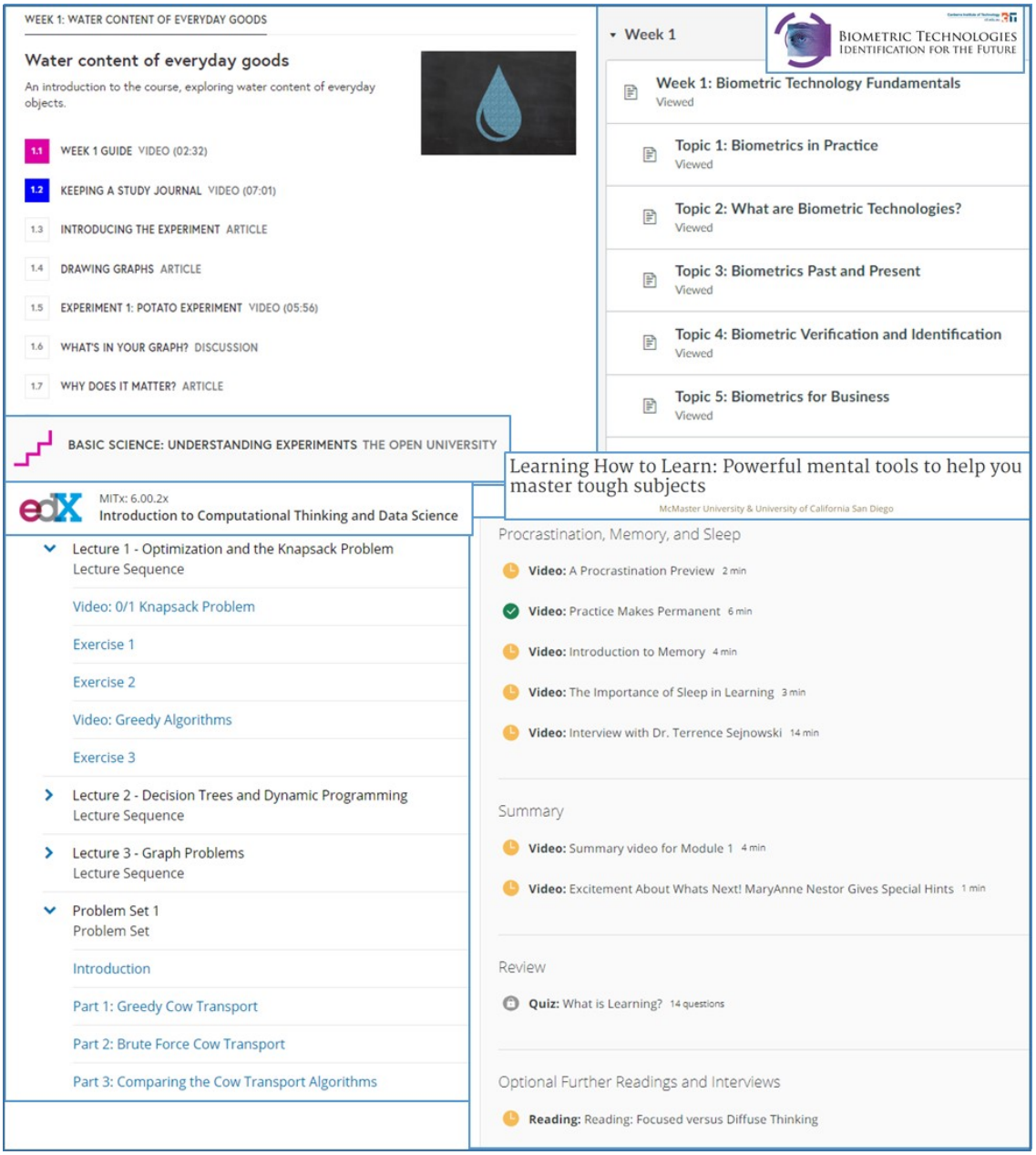

Figure 8. 13. Week syllabus in the sample

- Coursera offered rich information before enrolling in the MOOC, access to an FAQ and a syllabus divided by weeks. The length of each video and the total length of multimedia was shown, allowing a good estimation of the time that might be invested in watching them.

- For edX in contrast the time learners were expected to invest was not defined and seemed likely to be very demanding. An advantage in edX is that the MOOC was open for a long time period and facilitators were active in the forum discussions.

- Canvas did not offer access to all the educational resources from the beginning. Educational resources were only accessible sequentially. The MOOC main page offered information about the educational resources and the assignments to be completed per module. It is possible to configure notifications via email on a daily, weekly and monthly basis.

Table 8. 37. Different criteria for MOOC design

Criteria	FL	Coursera	edX	Canvas
10.1 MOOC syllabus	LA	LA	NA	LA
10.2 MOOC tools	PA	LA	NA	LA
11.1 Week syllabus	LA	FA	NA	PA
11.2 Week tools	LA	LA	NA	LA

In the *"MOOC design"* principle (**Figure 8.14**), there were differences between MOOCs in the way they showed the workload and syllabus to learners.

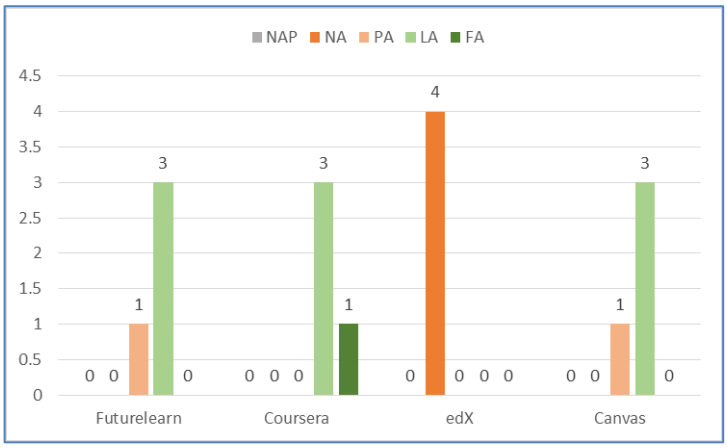

Figure 8. 14. MOOC design achievement level

8.4.5 Quality evaluation

The quality evaluation is divided into three principles.

The MOOC criteria

The *"massive"* (1.1.1) and *"online"* (1.3.1) guidelines were fulfilled. In all MOOCs there was no access limit beyond registration, they were available to be used on diverse devices and no formal qualifications were required to participate. All MOOCs included discussions and study guides at the beginning of the MOOC. In one provider due to the nature of the MOOC, there was a justified restriction for *"enrolment"* to be over 13 years old (1.2.1). The *"educational resources"* (1.5.1) included several formats (**Table 8.38**).

Table 8. 38. Success criteria for MOOC criteria

Criteria	FL	Coursera	edX	Canvas
1.1.1 Massive	FA	FA	FA	LA
1.2.1 Enrolment	FA	FA	FA	FA
1.2.3 Location	FA	FA	FA	FA
1.2.4 Prior knowledge	FA	FA	FA	FA
1.3.1 Online	FA	FA	FA	FA
1.5.1 Educational resource	FA	LA	LA	LA
1.5.2 Interactivity	FA	FA	FA	FA

Criteria	FL	Coursera	edX	Canvas
1.5.5 Syllabus	FA	FA	FA	FA

The average *"study unit"* (1.4.1) time recommended should be 25 to 30 hours, FL had a total of 12 hours, Coursera 9, edX 150 and Canvas 16. In one provider content was not *"accessible"* (1.2.2) from the beginning and in another one content was *"free"* (1.2.5) only for a limited time. One provider offered a free badge of completion (*"Certification"*, 1.5.4), others had paid options (1.2.5 and 1.5.4) (**Table 8.39**).

Table 8. 39. Failure and different criteria for MOOC criteria

Criteria	FL	Coursera	edX	Canvas
1.4.1 Study unit	NA	NA	NA	PA
1.2.2 Access	LA	FA	FA	PA
1.2.5 Free	PA	PA	LA	FA
1.5.4 Certification	NA	NA	NA	FA

The *"MOOC criteria"* principle had high achievement levels in the access, enrolment, location, educational resources and discussion. The study unit time was either too short or too long; content was not always available for free and often no free certification or badge was provided. (**Figure 8.15**)

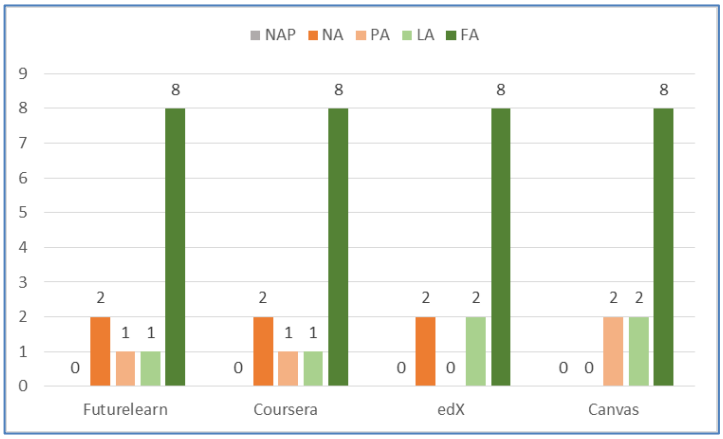

Figure 8. 15. MOOC criteria achievement level

Quality of the design

The criteria successfully addressed included *"pace"* (2.2.2), discussions, assignments and quizzes were always open, even when there was an indicative deadline. All MOOCs set an *"overall goal"* (2.3.1) and *"prior knowledge"* required (2.4.5 and 2.5.8) (**Figure 8.16 and Table 8.40**).

Various structures of assignments were offered with different formats allowing *"participation"* (2.5.8) with two providers including use of a Facebook group to collaborate. The *"educational resources*" (2.6.1, 2.6.4 and 2.6.5) had examples. *"Feedback"* (2.7.1 and 2.7.2) was often provided by facilitators in the discussion forums allowing scalability. Quizzes, in general, allowed checking learners' *"progress"* (2.8.4), typically on a weekly basis, and could be taken several times.

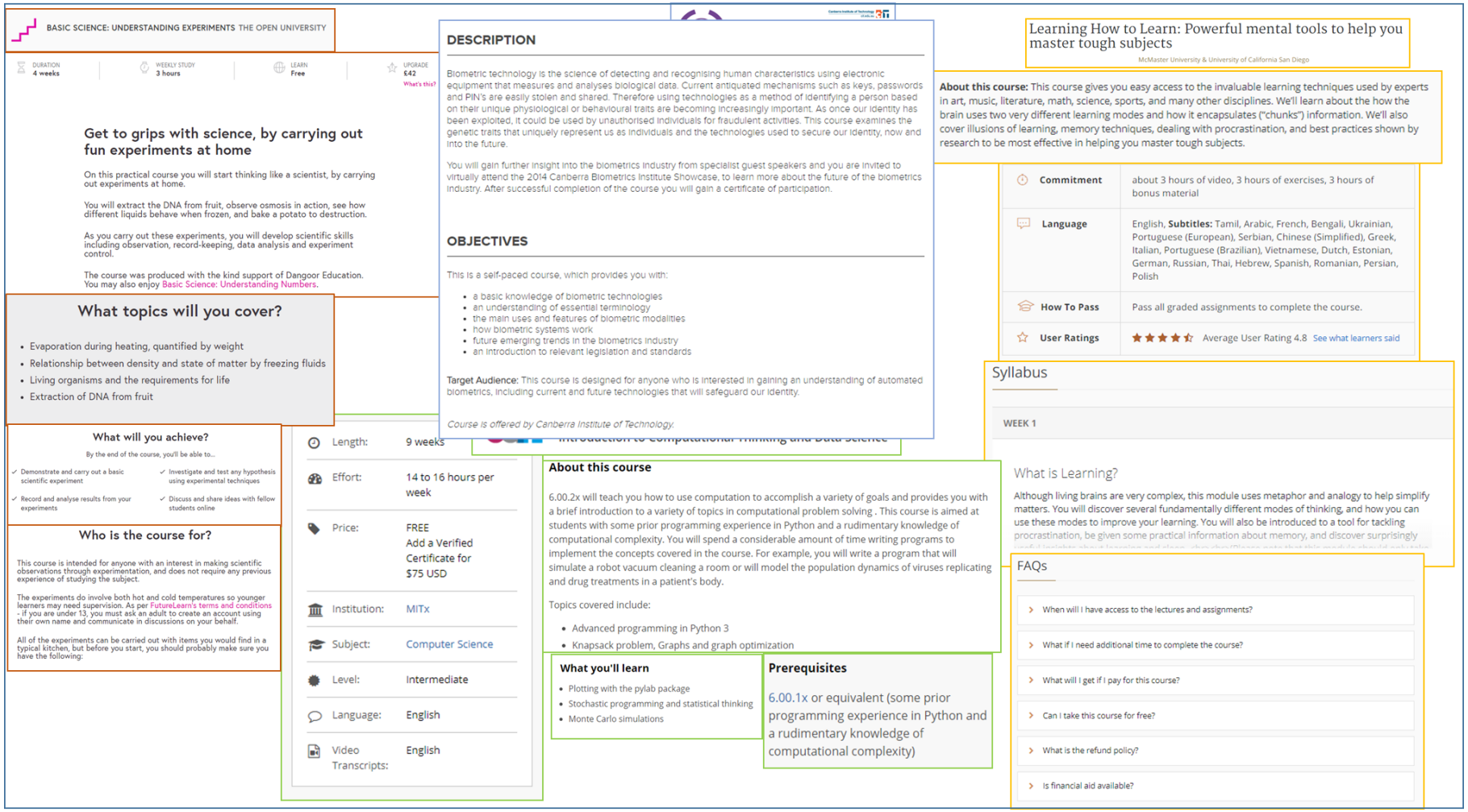

Figure 8. 16. MOOC main page information provided within the sample

Table 8. 40. Success criteria for the quality of the design

Criteria	FL	Coursera	edX	Canvas
2.2.2 Pace	FA	LA	LA	LA
2.3.1 Overall goal	FA	LA	FA	FA
2.4.1 Limited	FA	LA	FA	FA
2.4.5 Prior knowledge	FA	FA	FA	LA
2.5.8 Participation	FA	FA	FA	LA
2.6.1 Range	LA	LA	FA	LA
2.6.4 Consistency	FA	LA	LA	FA
2.6.5 Examples	LA	FA	LA	FA
2.7.1 Scalability	FA	FA	FA	FA
2.7.2 Regularity	FA	FA	LA	LA
2.8.4 Progress	LA	FA	LA	FA

The target group descriptions often did not clearly address requirements for *"prior knowledge"* (2.1.2). Where MOOCs offered a linear *"learning pathway"* (2.5.9), learners could not skip parts of the MOOC to vary the difficulty. For the sample MOOCs no *"live-events"* were scheduled (2.7.6) (**Table 8.41**).

Table 8. 41. Failure criteria for the quality of the design

Criteria	FL	Coursera	edX	Canvas
2.1.2 Prior knowledge	PA	PA	PA	PA
2.5.9 Learning pathways	PA	PA	NA	PA
2.7.6 Live events	NA	NA	NA	NA

Differentiation between *"target groups"* was weak (2.1.1). One provider identified various groups such as young learners, another at the beginning outlined groups with more or less experience and objectives, while a third one provided a wide range of learning goals to allow differentiation between groups. *"Workload"* (2.2.1) per week was suitable in most cases (around 3 or 4 hours) however one provider expected 10 hours per week. The *"learning goals and activities"* (2.4.2 - 2.5.10) were detailed by all providers:

- In FL there was no explicit differentiation on what to achieve from the assignments. Engagement seemed difficult since in every assignment learners could add comments to introduce questions or to answer other learners.
- In Coursera learners could decide how much to achieve in the P2P assignments and propose their own objectives, though learners still needed to take the quizzes to advance in the MOOC.
- edX assignments were compulsory and learners could not decide their achievement level.
- In Canvas there were only quizzes and educational resources, not assignments.

Three of the providers had *"license policy and information"* about their educational resources (2.6.2 and 2.6.3). The *"feedback mechanism"* (2.7.3 - 2.7.5) typically depended on following the comments from the facilitators and was not planned consistently. Providers each supported sending an email on a weekly basis

anticipating the content that is going to be studied in the next week, in one provider that notification could be configured to be daily.

The *"assessment"* (2.8.1 - 2.8.3) guideline was not applicable in one provider as the assignments were not accessible for free. Tests considered the learning goals and were aligned with the assignment outcomes and the educational resources. *"Plagiarism"* (2.8.2) was checked following different approaches, one provider checked it every time there was a test, in the other two providers learners agreed on avoiding plagiarism when signing up in the platform. Only one provider offered a free badge after completion (2.8.3) (**Table 8.42**).

Table 8. 42. Different criteria for the quality of the design

Criteria	FL	Coursera	edX	Canvas
2.1.1 Various groups	LA	LA	NA	LA
2.2.1 Schedule	FA	LA	NA	FA
2.4.2 Statement	FA	LA	LA	PA
2.4.3 Lifelong learning	FA	FA	PA	LA
2.4.4 Coherence	PA	LA	FA	FA
2.5.6 Assignments	FA	LA	LA	PA
2.5.7 Levels of difficulty	LA	LA	PA	PA
2.5.10 Engagement	PA	LA	LA	LA
2.6.2 License policy	NA	PA	NA	FA
2.6.3 License information	LA	PA	LA	FA
2.7.3 Frequency	PA	LA	FA	PA
2.7.4 Announcement	FA	FA	NA	FA
2.7.5 Synthesis	PA	PA	LA	NA
2.8.1 Learning goals	NAP	FA	LA	LA
2.8.2 Plagiarism	NAP	FA	FA	LA
2.8.3 Badge	NAP	PA	NA	FA

MOOCs offer a design that allow learners to work at their own pace, with an overall goal, identifying prior knowledge, allowing participation and consistent design in the *"Quality of the design"* principle. Failures were concentrated around the lack of defining different target groups and learning pathways. Differentiation appeared in strategies about the workload and learning goals management and assessment (**Figure 8.17**).

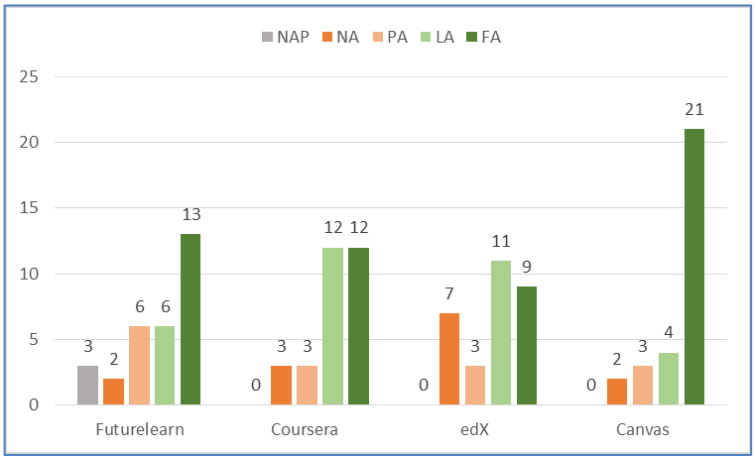

Figure 8. 17. MOOC criteria achievement level

Technical platform and support for learners

To configure the *"platform"* (3.1.1 and 3.1.2) two providers allowed changing the language. The *"support for MOOC learners"* (3.2) included profiling options and different approaches while offering technical guidelines:

- In FL learners could track their own comments. A *"using FutureLearn"* tab was available at platform level that contained a learning guide that could be downloaded in several formats.
- Coursera provided question marks icons in every single step to try to orientate learners. It offered an FAQ and guidance on pedagogical practices were provided in the MOOC.
- In edX learners could track forum posts, add notes, and track their progress in the profile. The provider included a *"demo MOOC"* to learn how to use the platform and an FAQ.
- Canvas allowed tracking of progress from the profile. There were general technical information and information on pedagogical practices at the beginning as well as an FAQ.

Table 8. 43. Success criteria for the technical platform and support for learners

Criteria	FL	Coursera	edX	Canvas
3.1.1 Reliability	LA	FA	LA	FA
3.1.2 Online tools	LA	FA	FA	FA
3.2.1 Profile	FA	LA	FA	LA
3.2.4 Technical guideline	LA	LA	FA	FA
3.2.5 FAQ	FA	LA	LA	FA
3.2.6 Pedagogical guideline	FA	FA	FA	FA

Two providers included extra support with the use of a Facebook group to allow external platform interaction between learners (3.2.2). In terms of *"help"* (3.2.3) in one provider, there was a button for administrative support and learners could follow facilitators' comments. Another provider had a help button

available in places such as P2P, quizzes or forums to redirect learners to the help centre. In general, there were no instructions to find help from or to contact the course team (**Table 8.44**).

For the *"feedback instructions"* (3.2.7) each provider followed different approaches:

- In FL assignments were self-evaluated. There was scope for improvement in the instructions to make the process more collaborative and have a productive discussion.
- Coursera detected the first-time learners were using the platform to provide extra information by default.
- edX offered guidelines to use the forums, though the instructions for P2P assignments were only available in a *"demo MOOC"*.
- In Canvas there were no specific instructions on use of the discussions.

Table 8. 44. Different criteria for the technical platform and support for learners

Criteria	FL	Coursera	edX	Canvas
3.2.2 Social networks	NA	NA	FA	FA
3.2.3 Help	PA	LA	FA	FA
3.2.7 Feedback instructions	PA	FA	LA	PA

For the *"Technical platform and support for learners"* principle the reliability of the platform, the profile configuration, the offering of FAQs, technical and pedagogical guidelines were achieved. There were differences in the support for MOOC learners around the use of social networks, help and feedback instructions (**Figure 8.18**).

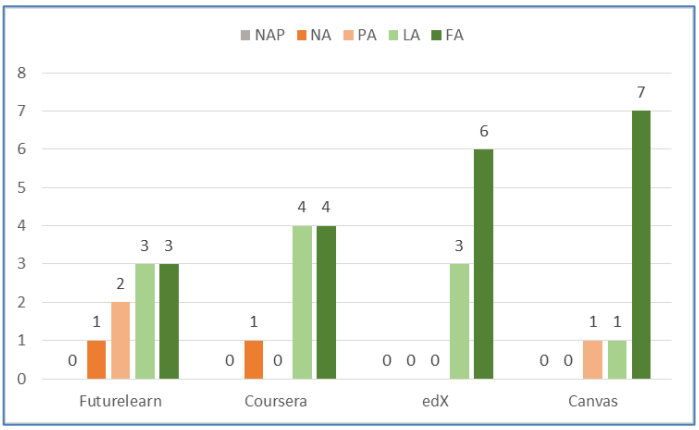

Figure 8. 18. Technical platform and support for learners achievement level

8.4.6 Learning design evaluation

Learning design evaluation is comprised of three principles following UDL.

Provide multiple means of engagement

In terms of engagement, all the platforms avoided *"distractions"* (7.3), though automatic notifications should be configured to allow more personalisation and persistence of preferences, for example when learners miss a week. All providers had problems in supporting learner *"goals"* and *"motivation"* (8.1 and 9.1). Two providers allowed learners to formulate their goals in the initial discussion, however learners could not visualise their goals across the MOOC. The motivation could be improved by all providers, three offering feedback at question level which provides a prompt to reflect, the other one limiting this to assignments. Providers failed to offer a space at the end of every week for integrative reflection within the learning design (**Table 8.5**).

Table 8. 45. Success and failure criteria for multiple means of engagement

Criteria	FL	Coursera	edX	Canvas
7.3 Minimise threats and distractions	LA	LA	LA	LA
8.1 Heighten salience of goals and objectives	NA	PA	NA	PA
9.1 Promote expectations and beliefs that optimise motivation	PA	PA	PA	PA

MOOCs offered limited options for what should be required for course completion *in "recruiting interest"* (7.1 and 7.2). In some cases assignments were not compulsory and in one provider the assessment was flexible, there was no time limit and unlimited tries (**Table 8.46**).

To provide options for *"sustaining effort and persistence"* (8.2-8.4, 9.2 and 9.3) providers followed different strategies:

- FL offered easy and explained tasks to achieve in the assignments, but not several levels of difficulty. There were discussions for specific tasks, but feedback was limited to the quizzes, where links to the educational resources within the course were provided.

- In Coursera learners had to pass 70% of the quizzes having 2 attempts per day, while P2P assignments were flexible and personal. There were several ways to collaborate using the forums with instructions to use them in a proactive way. There was no space for self-reflection, though feedback that encouraged reflection was provided in quizzes together with indications where to find further information.

- edX included several forums related to each assignment and there were general forums to raise questions and foster collaboration. There was clear information on how to collaborate, though there was a lack of feedback in the MOOC.

- Canvas included focused discussions. Quizzes did not provide feedback; however feedback was included in the videos and in the text-based files.

Table 8. 46. Different criteria for multiple means of engagement

Criteria	FL	Coursera	edX	Canvas
7.1 Optimise individual choice and autonomy	LA	LA	NA	PA
7.2 Optimise relevance, value, and authenticity	PA	LA	PA	PA
8.2 Vary demands and resources to optimise challenge	PA	LA	NA	NA
8.3 Foster collaboration and community	NA	LA	PA	LA
8.4 Increase mastery-oriented feedback	NA	FA	NA	LA
9.2 Facilitate personal coping skills and strategies	PA	LA	LA	PA
9.3 Develop self-assessment and reflection	NA	NA	PA	LA

In the *"engagement"* principle success was achieved to minimise threats and distractions while failures happened in heightening the salience of goals and promoting expectations. Differences were around optimising individual choice, fostering collaboration, increasing mastery-oriented feedback and developing self-assessment (**Figure 8.19**).

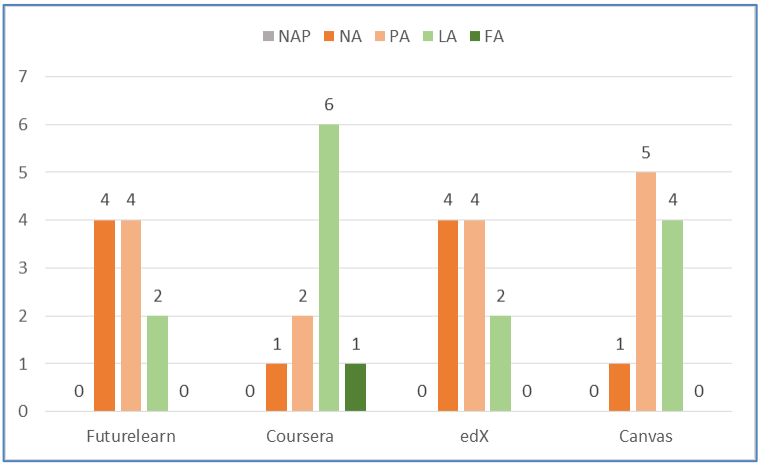

Figure 8. 19. Provide multiple means of engagement achievement level

Provide multiple means of representation

The *"sequential information"* (3.3) was achieved as the sequential order of each MOOC was clear. To *"maximise the generalisation"* (3.4) there were very limited tools to personalise learning, though in one provider it was possible to take notes. Another provider allowed saving of discussion entries, personalising a calendar and space to upload text-based files (**Table 8.47**).

Table 8. 47. Success and failure criteria for multiple means of representation

Criteria	FL	Coursera	edX	Canvas
3.3 Guide information processing, visualisation, and manipulation	FA	LA	LA	FA
3.4 Maximise transfer and generalisation	PA	PA	PA	PA

In terms of *"offering options for perception"* (1.1 – 1.3), providers did not offer options to change the presentation of content or options to change font size or auditory clues (**Table 8.48**). They did offer options to change the volume and rate in the videos. Each provider gave different types of support for perception:

- FL provided images with good resolution and images were sometimes used as an alternative to describe the content. There were transcripts available and downloadable.

- In Coursera, subtitles were available, transcripts could be played with the video though did not fit in the same screen. Transcripts and video could be downloaded in several formats; however audio did not include descriptive information.

- edX offered long videos (e.g. 15 minutes long) with videos being restarted from the same frame if they were stopped. Subtitles were available, transcripts could be played along with the video. Transcripts and videos could be downloaded. The transcripts did not fully cover the visual content, for example references to formulas were not transcribed.

- In Canvas only subtitles were available and there was no further descriptive information.

For "*language, mathematical expressions, and symbols"* (2.1 – 2.5), only one provider had available a glossary of general terms and a glossary for the MOOC, none of the providers had a dictionary available. Only two of the MOOCs in the sample made use of mathematical content, and in both cases, this was readable using the screen reader. One provider was fully available in different languages and offered subtitles and transcripts in a variety of languages. For two other providers the platforms are available in several languages but not the educational resources. For the remaining provider all the content is only available in English. For the *"structure and options for comprehension"* (3.1 and 3.2) each platform offers different options:

- FL kept the same structure within the MOOC. Connections to previous weeks were weak however there was an introduction and a summary every week and examples were provided.

- In Coursera connections were made at the end of the week and there was access to a general structure of the MOOC at any time. In the MOOC there was rich information from the beginning with key elements pointed out with examples.

- For edX, prerequisites were clear at the beginning of the MOOC, key elements in the videos were highlighted and there were examples. The structure was consistent and connections to previous knowledge were included in the video at the beginning of each week.

- In Canvas there was no strong link to previous knowledge or summary at the end of the week. Canvas MOOC offered differentiation of target groups and concepts to be studied and links to extra content. The MOOC provided examples though lacked clear organisation at the module level to highlight the relationships between the topics.

Table 8. 48. Different criteria for multiple means of representation

Criteria	FL	Coursera	edX	Canvas
1.1 Offer ways of customising the display of information	LA	PA	LA	PA
1.2 Offer alternatives for auditory information	LA	LA	LA	PA

Criteria	FL	Coursera	edX	Canvas
1.3 Offer alternatives for visual information	PA	LA	PA	NA
2.1 Clarify vocabulary and symbols	NA	LA	NA	NA
2.2 Clarify syntax and structure	LA	LA	LA	PA
2.3 Support decoding of text, mathematical notation, and symbols	NA	NAP	NA	NAP
2.4 Promote understanding across languages	NA	LA	PA	NA
2.5 Illustrate through multiple media	FA	PA	PA	LA
3.1 Activate or supply background knowledge	PA	LA	LA	LA
3.2 Highlight patterns, critical features, big ideas, and relationships	LA	LA	PA	PA

For the *"representation"* principle success was in guiding information while failures were in maximising transfer and generalisation. A large number of criteria differed to offer ways of customising the display of information, clarify vocabulary and syntax and promoting understanding across languages (**Figure 8.20**).

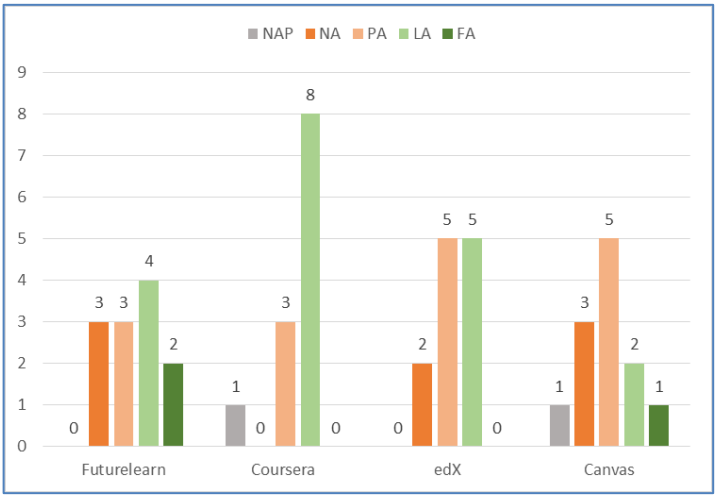

Figure 8. 20. Provide multiple means of representation achievement level

Provide multiple means for action and expression

In terms of *"levels of support for practice and performance"* (5.3), all MOOCs offered a single path to follow and there was a lack of differentiated feedback. Feedback was typically generated in automatic ways in quizzes and some assignments, though peers could provide feedback in discussions and P2P assignments. There was limited appearance of facilitators. *"Providing options for executive functions"* (6.1 and 6.2) MOOCs introduced objectives and goals at the beginning of the course but there was a lack of guidance for learners to build their own goals. Providers failed to provide prompts to help on self-reflection or checklists for the learner to prioritise tasks (**Table 8.49**).

Table 8. 49. Failure criteria for multiple means of action and expression

Criteria	FL	Coursera	edX	Canvas
5.3 Build fluencies with graduated levels of support for practice and performance	NA	PA	NA	PA

Criteria	FL	Coursera	edX	Canvas
6.1 Guide appropriate goal-setting	PA	PA	PA	PA
6.2 Support planning and strategy development	NA	NA	NA	NA

To provide options for *"physical action"* (4.1 and 4.2) it was usually possible to navigate the MOOC with the keyboard, though in one provider this failed within the video. None of the providers offered particular key commands instead making use of standard key commands accepted from the browser. Three providers scheduled restrictions to participate in the quizzes (**Table 8.50**).

For *"expression and communication"* (5.1 and 5.2), each platform used different approaches:

- FL used several means for expression including images and videos complementing the text. The MOOC did not provide external links however, in the weekly email learners get information related to external links in OpenLearn.
- In Coursera learners could choose between the use of videos, audio and text-based files.
- edX only used videos and also provided a calculator embedded in the platform. Extra information was made available as handouts and external links.
- Canvas used either videos or interactive text-based files. The MOOC offered multiple links to resources outside the platform.

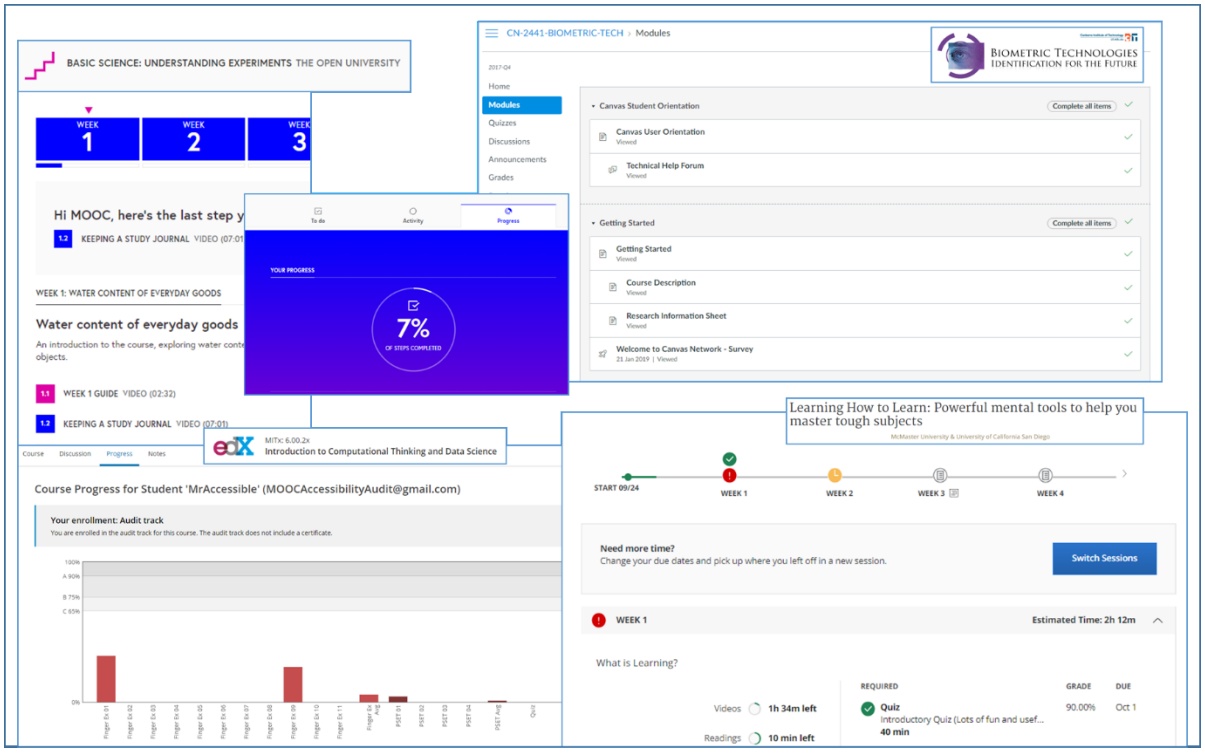

Figure 8. 21. MOOC progress information in the sample

Finally, for the *"options for executive functions"* (6.3 and 6.4), all platforms presented a visualization of the progress. For one of the providers progress reporting was limited to finishing the assignments, in the others

learners could track their progress based on the activities they have completed. Asking for help was relatively easy for technical support, though not for academic support.

Table 8. 50. Different criteria for multiple means of action and expression

Criteria	FL	Coursera	edX	Canvas
4.1 Vary the methods for response and navigation	LA	NA	LA	LA
4.2 Optimise access to tools and assistive technologies	PA	PA	LA	LA
5.1 Use multiple media for communication	LA	PA	PA	LA
5.2 Use multiple tools for construction and composition	PA	PA	LA	PA
6.3 Facilitate managing information and resources	LA	PA	PA	PA
6.4 Enhance capacity for monitoring progress	PA	PA	PA	LA

Failures for *"action and expression"* principle were shown in support for practice and performance, guide appropriate goal-setting and support. Differences included the methods for response and navigation, the use of multiple media for communication and capacity for monitoring progress (Figure 8.22).

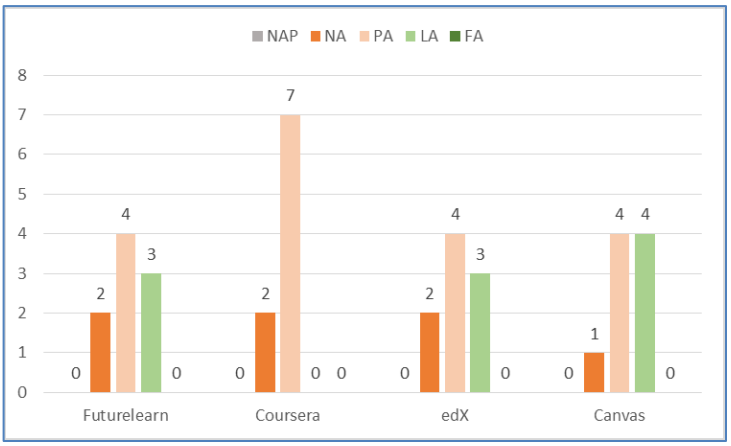

Figure 8. 22. Provide multiple means of action and expression achievement level

8.5 Discussion

The discussion details how the results from the implementation of the audit help to answer **RQ3a** (**Sections 8.4.2-8.4.6**); and how the audit's design, validation and implementation addresses **RQ3b** (**Sections 8.3.2-8.3.5**). The triangulation of the audit data with the other studies is described in **Section 9.2**.

RQ3. How can MOOCs be made accessible for disabled learners? - RQ3a. What is the current state of accessibility of MOOCs?

The investigation of information from the MOOCs providers in the sample showed that the accessibility information publicly made available by platform providers to course providers and learners on their websites needs to be improved. This information is useful for learners to understand if the platform is accessible and whether they will be able to report barriers, and for course providers to consider accessibility when developing MOOCs.

In summarising the state of accessibility an approach has been taken to cluster the audit results using a matrix for each of the components at the guideline level between successes and failures (**Tables 8.51 and**

8.52), selecting the lowest value between the four providers (e.g. if a criterion had two FA, one LA and one PA, it is classified as PA). Using the lowest value will highlight accessibility barriers by showing cases where a potential barrier for learners has been found, though it does not mean all providers evaluated are failing on that guideline.

Table 8. 51. Matrix-based on success criteria

Fully achieved	**Largely achieved**
Accessibility evaluation	
(1.2) Time-based Media: Captions (2.1) Keyboard Accessible: Keyboard (2.2) Enough Time: Interruptions, Page Titled Focus Order and Multiple Ways (3.2) Predictable; On Focus, On Input, Consistent Navigation and Consistent Identification	(1.2) Time-based Media: Audio-only and Video-only (1.3) Adaptable: Meaningful Sequence (1.4) Distinguishable: Images of Text (2.1) Keyboard Accessible: No Keyboard Trap (2.2) Enough Time: Timing Adjustable, Re-authenticating and Focus Visible (3.1) Readable: Reading Level (3.2) Predictable: Change in Request
UX evaluation	
	(2) Search and navigation: MOOC selection and MOOC registration (6) Assignment: Assignment achievement (7) Discussion: Discussion interaction and Discussion adding comments
Quality evaluation	
(1.2) Open: enrolment, location and prior knowledge (1.5) Full course: interactivity and syllabus (3.2) Support for MOOC learners: Pedagogical guideline	(1.1) Massive (1.5) Full course: educational resource (2.2) Workload: pace (2.3) Overall goal (2.4) Learning goals: limited and prior knowledge (2.5) Learning activities: participation (2.6) Resources: range, consistency and examples (2.7) Feedback mechanism: scalability and regularity (2.8) Assessment: progress, learning goals and plagiarism (3.1) Platform: reliability and online tools (3.2) Support for MOOC learners: profile, technical guideline and FAQ
Learning design evaluation	
	(7) Recruiting interest: Minimise threats and distractions (3) Comprehension: Guide information processing, visualisation, and manipulation

Technical accessibility evaluation. All MOOCs provide subtitles, transcriptions or an alternative format, being downloadable in a text-based file or played with the video. In all cases the keyboard is accessible, and timing in quizzes and tests is adjustable. Learners can continue activity without loss of data after re-authenticating. Pages have unique and descriptive titles; major items follow a logical sequence and content can be found via either a search function or a sitemap. Text provided in all MOOCs is comprehensible and written in simple sentences. A meaningful sequence of styles is provided, navigation and component labels are consistent across pages.

UX evaluation. Information in the MOOC main page is simple and self-explanatory. Providers offer different personalisation options such as being able to save unfinished assignments and quizzes, add notifications, follow other learners, and filtering posts.

Quality evaluation. Providers comply with the definition of massive provided in **Section 2.5.** All content of the courses is delivered online. There is no access limit other than registration. MOOCs are available for all devices and no formal qualification is required to participate. All providers include discussion forms and

study guides. Learners can advance at their own pace; discussions, assignments and quizzes are always open. All MOOCs set an overall goal and information on learning goals and prior knowledge are present.

Educational resources retain consistency and provide examples. Quizzes allow learners to check progress on a weekly basis and can be taken several times. Providers include profiling options such as tracking comments, being able to add favourites and notes, and to track progression. Platforms provide FAQs and technical and learning guides in several formats.

Learning design evaluation. MOOCs avoid distractions and allow some personalisation. The sequential order is clear for all MOOCS and the learner can access the content in different ways.

Table 8. 52. Matrix-based on failure criteria

Partially achieved	**Not achieved**
Accessibility evaluation	
(1.2) Time-based Media: Audio Description or Full-Text Alternative (2.4) Navigable Headings and Labels and Location (3.1) Readable: Language of Parts (3.3) Input Assistance: Error Identification and Labels or Instructions (5) Logical Structure	(1.1) Text Alternatives: Non-text Content (1.2) Time-based Media: Audio Description, Extended Audio Description, Media Alternative and Sign Language (1.3) Adaptable: Info and Relationships (1.4) Distinguishable: Use of Colour, Contrast, Resize text and Visual Presentation (2.2) Enough Time: No Timing (2.4) Navigable: Bypass Blocks, Link Purpose and Section Headings (3.1) Readable: Language Page, Unusual Words, Abbreviations and Pronunciation (3.3) Input Assistance: Error Suggestion, Help and Error Prevention (4.1) Compatible: Parsing, Name, Role, Value (5) Basic Requirements, Metadata and Settings
UX evaluation	
(1) Registration and sign in: MOOC platform sign in and Password recovery (3) Video: Video interaction (4) Article: Article interaction (5) Electronic file: File download (6) Assignment; Assignment instructions and Assignment evaluation (8) Quiz-Test: Quiz interaction and Quiz feedback	(1) Registration and sign in: MOOC platform registration (2) Search and navigation: MOOCs search (5) Electronic file: File interaction (9) help: Help contact and Help interaction (10) MOOC experience: MOOC syllabus and MOOC tools (11) Week experience: Week syllabus and Week tools
Quality evaluation	
(1.2) Open: access, free (2.1) Target group: prior knowledge (2.4) Learning goals: statement, lifelong learning and coherence (2.5) Learning activities: assignments, levels of difficulty and engagement (2.6) Resources: license information (2.7) Feedback mechanism: frequency (3.2) Support for MOOC learners: help and feedback instructions	(1.4) Course: study unit (1.5) Full course: certification (2.1) Target group: various groups (2.2) Workload: schedule (2.6) Resources: license policy (2.7) Feedback mechanism: live events, announcement and synthesis (2.8) Assessment: badge (3.2) Support for MOOC learners: social networks
Learning design evaluation	
(7) Recruiting interest: Optimise relevance, value, and authenticity (9) Self-regulation: Promote expectations and beliefs that optimise motivation, Facilitate personal coping skills and strategies (1) Perception: Offer ways of customising the display of information, Offer alternatives for auditory information (2) Language and symbols: Clarify syntax and structure, illustrate through multiple media, Maximise transfer and generalisation	(7) Recruiting interest: Optimise individual choice and autonomy (8) Sustaining effort and persistence: Heighten salience of goals and objectives, vary demands and resources to optimise challenge, Foster collaboration and community, Increase mastery-oriented feedback (9) Self-regulation: Develop self-assessment and reflection (1) Perception: Offer alternatives for visual information (2) Language and symbols: Clarify vocabulary and symbols, Support decoding of text, mathematical notation, and symbols, Promote understanding across languages

Partially achieved	Not achieved
(3) Comprehension: Activate or supply background knowledge, Highlight patterns, critical features, big ideas, and relationships (4) Physical action: Optimise access to tools and assistive technologies (5) Expression and communication: Use multiple media for communication, Use multiple tools for construction and composition (6) Executive functions: Guide appropriate goal-setting, facilitate managing information and resources, Enhance capacity for monitoring progress	(4) Physical action: Vary the methods for response and navigation (5) Expression and communication: Build fluencies with graduated levels of support for practice and performance (6) Executive functions: Support planning and strategy development

Technical accessibility evaluation. Providers are failing to include alternative descriptions in images and have accessibility issues in the use of forms, links, headers, document structure and colour contrast. It is not possible to resize text or change the visual presentation (i.e. change the order of the content in the browser). None of the MOOCs include glossaries, sign language interpretation, and the videos rely on visual information (i.e. no alternative format to visual information is provided).

There is a lack of context-sensitive help to provide information related to the function currently being performed and input assistance for error prevention and identification. Text-based files have problems with the content, natural language and metadata.

UX evaluation. The MOOC search page and registration show usability problems. Videos are not always downloadable; subtitles and transcripts appear in the margins hindering reading. Videos are the only educational resource provided in some MOOCs. Text-based files can be downloaded but do not support setting font size, alternative text, or use of formulas within the content.

Instructions for assignments and their evaluation are not always present. Quizzes use ordered questions with the learner forced to follow a sequential order. All the questions may be on a single page, and feedback is not available to reinforce positive answers. Providers lack a help button to report accessibility errors. In the MOOC design, not all platforms allow access to the content of the MOOC from the beginning. There is no discussion area at MOOC level; the work learners are expected to achieve is not defined and can be very demanding.

Quality evaluation. Average study time is not followed in the workload. The entire content of MOOCs is sometimes not available from the beginning, or the content is only available for a limited time. Learners have to access the MOOC sequentially. Target groups are not addressed. A single learning pathway is offered where learners cannot skip parts of the MOOC and there are no different levels of difficulty. There is no explicit indication of what to achieve from the assignments and no space for learners to formulate their goals. Not all MOOCs link the learning strategy, assessment method and use of discussion with the learning goals. The feedback mechanism has not been planned consistently and support is only available in some parts (e.g. quizzes and assignments).

Learning design evaluation. MOOCs are not motivating learners to formulate their learning goals. Feedback does not act as a prompt to reflect, lacking space at the end of every week for integrative reflection and, in general, space for self-reflection. There is a lack of definition for course completion and of several levels of

complexity. Discussions are not always available for each assignment to raise questions and for collaboration. MOOCs limit options to personalise the learning, with no space to personalise learners' work or options to change the content presentation. There is a lack of alternative resources and a predominance of video. There is a lack of a glossary of terms and dictionary. Not all MOOCs have content available in different languages.

In MOOCs, connections to content in the previous weeks can be weak. Examples fail to highlight the relationships between the topics. There is a single path to follow and a lack of differentiated feedback and more input is needed from facilitators. MOOCs provide objectives and goals at the beginning of the course but there is a lack of examples and guides for learners to build their own goals. MOOCs fail to provide prompts to help on self-reflection or checklists for the learner to help prioritise tasks and steps. There are timing restrictions in quizzes. Help can be accessed in some contexts such as in quizzes, forums or assignments; however, this does not allow to report accessibility barriers.

RQ3. How can MOOCs be made accessible for disabled learners? - RQ3b. How can accessibility barriers in MOOCs be identified and addressed?

For the identification of accessibility barriers, the MOOC accessibility audit is useful for the following reasons:

- **Visualisation**. The visualisation of the results helps to establish comparisons and find the differentiation between the four components of the audit, focusing where achievements and errors are occurring (**Figure 8.23**).

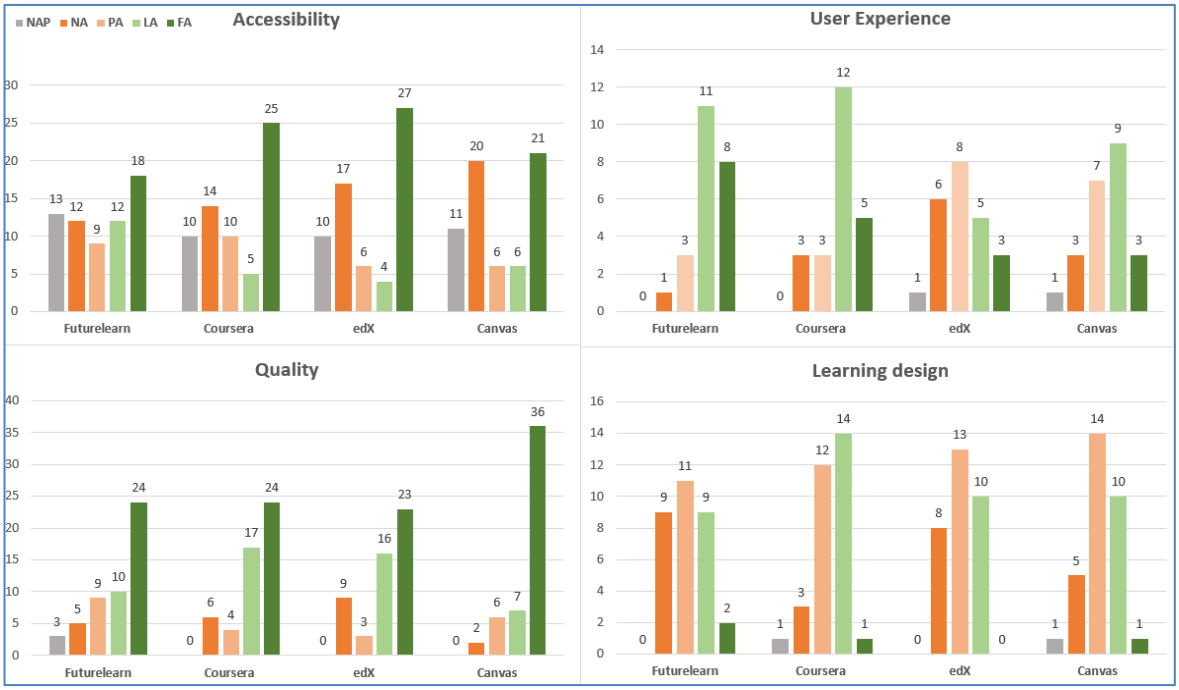

Figure 8. 23. Summary of the audit results

- **Overlap**. There is an overlap between criteria in the different components of the audit. These similar criteria can get a different rating reflecting differences between the components: different origin and instructions in the *"what to test for"* and *"testing method"* sections. An example is the use of a keyboard, achieving success when considered in the technical accessibility component, while the learning design detected problems in accessing videos. Differences have been shown in other aspects such as the colour contrast, that overlap enriches the results and covers perspectives from different components.

- **Strength.** Criteria have different strengths in their application, as with the *"overlap"* this is a reflection of the different origin and adaptation of the components. An example is the criteria on learning goals in the quality component which implies reviewing the existence of adequate educational resources proposed in the MOOC. For the learning design component the criteria on learning goals include aspects such as their consistency in quizzes or assignments. In the last component the learning goals are evaluated in a more detailed way making success harder to achieve. **Figure 8.23** shows that strength difference visually.

- **Inconsistency**. Inconsistency between criteria helps to identify barriers, but the findings can be contradictory. For example, in pedagogical terms, the quality and learning design components propose the use of social networks and external resources, while from accessibility and UX components, such resources can contribute to accessibility barriers.

- **Complementarity.** The audit has shown the components are complementary: the technical accessibility and UX components are examining barriers linked to technical aspects; while quality and learning design can help to find barriers related to learning.

The validation process has been helpful to recognise the audit as a valuable tool to identify and address accessibility barriers:

- **Strengthening.** The implementation of the audit is reinforced by using the final agreements. Comparing opinions with other raters in each of the components has helped to improve the content of the checklist, enriching them and adding golden items.

- **Coverage.** 50% of the evaluations included in the sample for the audit agreed in the validation process between two evaluators, with the percentage being supported by the literature (Strijbos et al., 2006; Strijbos & Stahl, 2007).

- **Agreement.** Agreements according to Cohen's Kappa are substantial and moderate. These values imply a reasonable agreement within the scale (**Table 8.53**).

Table 8. 53. Cohen's Kappa between evaluators

Accessibility audit	FL	Coursera	edX	Canvas
1. Technical accessibility evaluation	0.75 - substantial agreement			
2. UX evaluation	0.74 - substantial agreement		0.49 - moderate agreement	

Accessibility audit	FL	Coursera	edX	Canvas
3. Quality evaluation		0.51 - moderate agreement		0.41 - moderate agreement
4. Learning design evaluation		0.55 - moderate agreement	0.55 - moderate agreement	0.59 - moderate agreement

- **Discussion.** The use of the matrix in **Table 8.54** shows the resolution of the final agreements between raters. From the 72 guidelines included in the audit, 26 final agreements were PA and 30 LA, which shows the inter-reliability critical process to produce median values.

Table 8. 54. Matrix-based on final agreements percentages

Fully achieved	Partially achieved
6.94% (5)	36.11% (26)
Largely achieved	**Not achieved**
41.6% (30)	15.27% (11)

- **Future improvements:** The validation process served to shed light on the limitations of the current design of the audit and point out possible improvements for future design and implementation of the audit tool (**section 9.6**).

Review of the RQs answered in this study

As identified by Sanchez-Gordon and Luján-Mora (2017) in their literature review and shown in **Section 2.8**, previous evaluation of accessibility in MOOCs has been varied but with limitations. In this research, the accessibility barriers that were identified are not necessarily technical, but rather include learning design aspects as well. The barriers identified through this audit can also account for many factors which are not necessarily related to disability. For example, from the learners' perspective (**Section 6.7**), lack of time to perform the tasks assigned each week may be related to a very busy personal life which may affect learners, or barriers could be due to mental health problems which influence ability to concentrate on tasks. Another example is a barrier related to the different approaches learners have to interact with other peers: while this may apply generally it will be of greater impact when the learner has low self-esteem and is particularly sensitive to receive negative feedback. One of the most common issues raised by providers is their limited capacity to support learners experiencing accessibility barriers once a MOOC is already online and being run (**Section 4.7**). Most of the providers' accessibility knowledge comes from barriers reported by learners during the courses, and learners may have different behaviours while looking for help (Corrin et al., 2017), which may also be influenced by disability.

The accessibility audit has shown that there is scope for improvement in technical areas such as the registration processes, learners profiles, search pages and information provided before enrolling the MOOC. Some of these barriers had been identified in previous research indicating resilience to address accessibility by MOOC providers (Bong & Chen, 2016; Martin et al., 2016). For design areas the audit has highlighted issues with the overall MOOC and weekly workload, information around assignments, use of discussions, motivation and scope for self-reflection, collaborative work, and feedback in courses.

The conversations with providers have shown the limitations of MOOC production to provide dynamic solutions to accessibility barriers (**Section 4.7**). Disabled learners have shown that they have ways of

responding to the barriers they face, which in many cases enables them to find a way to keep on working through the MOOC. However, the responses formulated are different from the solutions they would want to find (**Section 6.7**). It is, therefore, necessary to strengthen mechanisms that involve the participation of learners in MOOC design (Iniesto & Rodrigo, 2018). In **Section 2.8.2** previous research has shown the need to draw on legislation, frameworks and services to address accessibility (Anastasopoulos & Baer, 2014; Sanchez-Gordon & Luján-Mora, 2015b; Xiao et al., 2015). The accessibility audit has proven to be a holistic and viable tool that providers can use to identify barriers and facilitate processes to address the barriers.

8.6 Conclusions

In this chapter the accessibility audit has been validated with the use of an inter-reliability process which has helped identify its strengths and limitations. The audit has helped to understand the current state of accessibility in MOOCs (**RQ3a**). In addition, the accessibility audit has helped to identify and proposed ways to address accessibility barriers (**RQ3b**).

The next chapter consists of the conclusions, summary of the contributions, implications and limitations of this research.

9. Conclusions

MOOCs have the potential to provide learners with the flexibility to learn, opportunities for social learning, and to gain new skills and knowledge as discussed in **Section 2.4**. While MOOCs have the potential to bring these benefits to disabled learners, there is little understanding of how accessibility is embedded in the design and development of MOOCs **(Section 2.8)**. This research project has aimed to improve the understanding of accessibility barriers in MOOCs and developed processes to identify and address those barriers via an accessibility audit.

This research has recognised the value of considering both provider and learner opinions to investigate their perspectives of accessibility (**Sections 2.6** and **2.7**). This thesis has provided findings that should lead to more accessible MOOCs and increase awareness among the various stakeholders of the need for accessible MOOCs. This research project addresses three research questions to study accessibility in MOOCs through three studies. The three research questions addressed are:

- **RQ1**. How do MOOC providers cater for disabled learners?
- **RQ2**. What are the motivations of disabled learners when taking part in MOOCs?
- **RQ3**. How can MOOCs be made accessible for disabled learners?
    - **RQ3a**. What is the current state of accessibility of MOOCs?
    - **RQ3b**. How can accessibility barriers in MOOCs be identified and addressed?

Study A (Chapter 4) examined the thinking and issues identified by MOOC providers through a series of interviews with those involved in the production and presentation of MOOCs (addressing **RQ1** and **RQ3**). **Study B** (Chapters 5 and 6) focused on learners employing mixed methods to combine secondary analysis of surveys with targeted interviews with learners (**RQ2** and **RQ3**). **Study C** (Chapters 7 and 8) developed an applied an accessibility audit that combined four components to evaluate four MOOC platforms and the audit tool itself was validated (**RQ3**). This chapter summarises the conclusions from this doctoral research.

9.1 Introduction

In **Section 9.2**, there is a discussion on how the results from the three studies triangulate to provide supporting evidence. A summary of the main contributions against each of the research questions is in **Section 9.3**. The implications from this research project are discussed in **Section 9.4**. The limitations and directions for future research are in **Sections 9.5** and **9.6**, respectively. Concluding remarks from this research project are detailed in **Section 9.7**.

9.2 Triangulation from the three studies

The three studies included in this research have generated data about accessibility barriers and the ways to address them (**RQ3**). Using the MOOC structure introduced in **Section 2.5**, the data can be triangulated and common themes brought out across various aspects. **Table 9.1** details the themes from the thematic analysis (studies A and B) and the principles from the accessibility audit implementation (Study C) that

influence the triangulation. For each area of the MOOC structure, the audit has helped to test ideas from the previous studies and highlight agreements. As discussed in **Section 8.5,** the audit has overlapping criteria; therefore, it informs many same barriers from several of its components. Due to the richness of the data across each of the studies, the examples given below are only representative of the entire data-set.

Table 9. 1. Data triangulation from themes of Study A and B and principles in Study C

MOOC structure	**Study A (Themes and sub-themes)**	**Study B (Themes)** ***Barriers, Responses and Solutions***	**Study C (Principles)**			
			Accessibility evaluation	**UX evaluation**	**Quality evaluation**	**Learning design evaluation**
Platform design and access	*"Platform design and access "*	*"Platform design and access"*	(1) Perceivable (2) Operable (3) Understandable (4) Robust	(1) Platform design and access	(3) Technical platform and support for learners	(1) Engagement (2) Representation (3) Action and expression
MOOC design	*"MOOC learning processes"*	*"MOOC design"*	(1) Perceivable (2) Operable (3) Understandable	(2) MOOC design	(1) The MOOC criteria	(1) Engagement (2) Representation (3) Action and expression
Educational resources	*"Educational resources"*	*"Educational resources"*	(1) Perceivable (2) Operable (3) Understandable (5) Text-based files	(3) Educational resources	(2) Quality of the design	(1) Engagement (2) Representation (3) Action and expression
Discussion, assignments, tests and quizzes	*"Discussion, assignments, tests and quizzes"*	*"Discussion, assignments, tests and quizzes"*	(1) Perceivable (2) Operable (3) Understandable	(4) Discussion, assignments, tests and quizzes	(2) Quality of the design	(1) Engagement (2) Representation (3) Action and expression
Help: Report and feedback	*"Help: Report and feedback"*	*"Help: Report and feedback"*	(1) Perceivable (2) Operable (3) Understandable	(5) Help: Report and feedback	(3) Technical platform and support for learners	(1) Engagement (2) Representation (3) Action and expression

Examples of triangulation are introduced in the following subsections using the MOOC structure.

Platform design and access

Providers (Study A) and learners (Study B) suggested it should be possible to set up default configuration values in the learners' profile. Possible configuration values could include the platform language, switching on or off subtitles and transcripts when playing videos, notifications, fonts size, contrast and the content-disposition. The UX component of the audit (Study C) identified these needs. See **Sections 4.6.4** and **6.5.2** theme *"Platform design and access"* and **8.4.4** principle *"Platform design and access"*.

Feedback from learners (Study B) and the findings from the learning design component of the audit (Study C) highlighted the relevance of including built-in applications such as a word processor, calculators and dictionaries in several languages. See **Sections 6.5.2** theme *"Platform design and access"* and **8.4.6** principle *"Engagement".*

MOOC design

The quality component of the audit (C) and data from the providers (A) indicated the need to incorporate a syllabus with the information available weekly to provide learners with a clear idea of the learning activities included. Providers and learners (A and B) indicated preference that all the content of the MOOC should be available from the beginning (e.g. access to all educational resources, discussion, assignments, tests and quizzes should be open from the start). That aspect would allow learners plan their study time with greater flexibility. Learners (B) agreed it is desirable to have information about the availability of accessibility features (e.g. subtitles, transcripts, available languages and the different educational resources formats provided). See **Sections 4.6.3** theme *"MOOC learning processes"*, **6.5.2** theme *"MOOC design"* and **8.4.5** principle *"The MOOC criteria"*.

Educational resources

Learners (B) and providers (A) suggested that videos should be shorter (e.g. between 3 and 5 minutes) to keep learners' attention. The audit (C) confirmed this through its accessibility, quality and learning design components. It was also suggested these videos should point out key elements with examples and that accessibility needs to be maintained in situations when the course team needs to use a board or draw on the presentation: for example, the content needs to be clearly explained especially in the use of mathematical formulas and including equivalent handouts or extended audio descriptions. See **Sections 4.6.4** theme *"Educational resources"*, **6.5.2** theme *"Educational resources"*, **8.4.3** principle **"**Perceivable", **8.4.5** principle ***"****Quality of the design"* and **8.4.6** principle ***"****Representation"*.

Discussion, assignments, tests and quizzes

Learners (B) and providers (A) agreed that assignment instructions should be clear especially if there is any evaluation from peers (i.e. P2P assignments). Assignments, tests and quizzes have to be aligned with the learning goals proposed in the MOOC. Discussions should be designed by themes and topics and to foster collaboration between learners (i.e. introduce clear information about the correct use of the discussions to promote proactivity and positive feedback), as identified by providers (A) and the UX, quality and learning design components of the audit (C). These aspects help learners to have a better understanding of MOOCs operation, they allow learners to feel more comfortable and integrated while using the learning environment. See **Sections 4.6.4** theme *"Discussion, assignments, tests and quizzes"***, 6.5.2** theme *"Discussion, assignments, tests and quizzes"***, 8.4.4** principle *"Discussion, assignments, tests and quizzes"***, 8.4.5** principle ***"****Quality of the design"* and **8.4.6** principle *"Engagement"*.

Help: Report and feedback

Learners (B), providers (A) and the UX and quality components of the audit (C) each indicated the difficulties in finding help by learners. At the platform level there was a lack of technical and learning guides, and at MOOC level, there was a lack of help focused discussions for learners where facilitators and technical specialists could provide support. See **Sections 4.6.4** theme *"Help: Report and feedback"***, 6.5.2** theme *"Help:*

Report and feedback", **8.4.4** principle *"Help: Report and feedback"* and **8.4.5** principle *"Technical platform and support for learners".*

Conclusions from the triangulation

The three studies have provided rich data, much of which aligns with other findings as many of the accessibility and UX barriers found were already identified in reported research on other (not MOOC) LMSs (Acosta & Luján-Mora, 2016; Alahmadi & Drew, 2016; Iglesias et al., 2014; Rodríguez et al., 2017) (**Section 2.8**). Those findings linked to technical aspects have also been highlighted by MOOC researchers (Akgul, 2018; Calle Jimenez et al., 2014; Martin et al., 2016; Sanchez-Gordon & Luján-Mora, 2013b, 2016c; Sanderson et al., 2016) (**Section 2.8.1**). In line with Straumsheim (2017), repeated identification of barriers indicates the slow speed in improving accessibility in educational technology; the same barriers are identified, but solutions are not yet provided.

The studies within this thesis have been innovative in terms of identifying quality and pedagogical accessibility barriers, which have not been comprehensively explored in previous research (Park et al., 2015). The data gathered has also allowed barriers to be identified that are linked with the MOOC definition used for this thesis (**Section 2.5**). These barriers can be caused by the way MOOCs are limited to a specific time frame generating barriers for many learners who cannot follow the workload. The term open is also creating friction within the stakeholders: often in current MOOCs educational content is not accessible from the beginning or access to it is lost when the course is finished. The massiveness intended of MOOCs further implies a greater predisposition to be accessible. It is complicated to provide help once the MOOC is online, improvements in the help reporting services need to be in place in advance.

9.3 Contributions to knowledge

The combination of qualitative studies through interviews with MOOC providers and learners and the quantitative information provided by the MOOC survey data has provided an in-depth and multi-faceted insight into accessibility needs of MOOC learners. The MOOC accessibility audit has helped to identify accessibility barriers and the audit provides a tool that can be used and iteratively developed further to support the design and evaluation of MOOCs for accessibility. This section summarises the main contributions for each of the research questions. Study A addressed **RQ1** and **RQ3**, Study B addressed **RQ2** and **RQ3**, and Study C addressed **RQ3**.

RQ1. How do MOOC providers cater for disabled learners?

As discussed in **Section 2.6** and also highlighted by Haavind & Sistek-Chandler (2015) and Papathoma (2019), there is limited research on experiences of MOOC providers and how their course teams are trained, and how they interact with learners. Smith et al. (2017) included the experiences of educators involved in the process of developing a MOOC including accessibility. Study A has identified that there is awareness amongst the MOOC providers of disabled learners participating in MOOCs (**Section 4.7**); however the providers have acknowledged limitations in this project:

- **Understanding of disabled learners**. MOOC providers do not know who is participating in their MOOCs leading to a lack of understanding of their learners, and, in particular, for disabled learners.

- **Accessibility information**. MOOC providers do not gather accessibility information or requirements from their learners as is typical of other educational environments (Porter, 2014).

- **Technology barriers.** MOOC providers pre-agreed technology of the platforms is creating barriers. MOOCs use social media, third-party software and technologies that may not be accessible for all learners. The providers in the investigations were aware of limitations for learners to find help, report accessibility barriers, and to get feedback.

- **Legislation.** MOOC providers prioritise legislation over disabled learners' preferences.

Providers agreed in the following benefits (value-added) for disabled learners participating in MOOCs:

- **Professional Development**. Participating in MOOCs allows certification, which may benefit the participation of disabled learners in the labour market as disabled learners report higher percentages of unemployment (Dennen & Bong, 2017; Powell, 2018).

- **Low cost.** Values of openness and low cost, where present, help disabled students who have greater likelihood of facing economic disadvantages than the general population.

- **MOOC self-regulation.** MOOCs allow social interaction, which is facilitated by their massiveness and that learners can work from their preferred environment (for example at home with a laptop which includes assistive technologies) (Wong et al., 2015). This flexibility helps students in their self-regulated learning experience (Littlejohn et al., 2016).

The factors reported have a direct influence in limiting availability of accessible educational resources as MOOC providers are not designing the educational resources for different target user-groups and are not allowing personalisation of the learner experience to help overcome accessibility barriers (Daniel et al., 2015). Providers are also missing the opportunity to get more comprehensive feedback from learners to help them better support accessibility over time (Coughlan et al., 2017).

RQ2. What are the motivations of disabled learners when taking part in MOOCs?

The results of Study B have similarities with the previous research identified in **section 2.7** about the value of including disabled learners' perspectives in the design and conduct of MOOCs. The motivations of disabled learners to participate in MOOCs are broad and depend on factors already identified such as improving professional development, leisure or social interaction, (Ilgaz & Gulbahar, 2017; Sablina et al., 2018; Serdyukov & Serdyukova, 2015). To understand the motivations of disabled learners as reported in **Sections 5.9 and 6.7** there are several other aspects to consider:

- **MOOC participation.** The number of disabled learners participating in MOOCs, from the data analysed in this research, is lower than reported in other distance learning environments (Law et al., 2013; The Open University, 2018b).

- **Continuing professional development (CPD).** Disabled learners find MOOCs useful for personal development and CPD, and as a route for access to HE (Watted & Barak, 2018).

- **Low cost.** Disabled learners consider the low-cost of MOOCs to be an important factor.

- **MOOC self-regulation.** Disabled learners are interested in the facilities MOOC offer in terms of flexibility and self-regulation so that they can work from any place with access to the internet. MOOCs are seen by them to offer a more friendly environment as compared to classroom attendance.

Learners reported similar motivations to MOOC providers, such as MOOCs are flexible and enable them to learn at their desired pace and place. MOOCs are low-cost and provide possibilities for CPD and access to HE. Some of these motivations are at risk since, as reported above (**Section 9.2**), low cost and openness are not a priority in the recent business models being adopted by MOOC providers.

RQ3. How can MOOCs be made accessible for disabled learners?

The conclusions from the triangulation in the previous section have specified the overlap and innovations provided from the three studies included in this research with previous research discussed in **section 2.8**. To understand the current state of accessibility in MOOCs (**Sections 4.7, 6.7 and 8.5**), these are some summary points:

- **Accessibility barriers.** Accessibility barriers can be technical but also include the learning design and human factors which are not necessarily related to disability. Barriers can be found in several places, including the registration processes, search pages, information provided before enrolling, in carrying out assignments or the use of discussions.

- **Accessibility information**. MOOC providers get to know about some barriers thanks to learners reporting them when MOOCs are being run. Providers acknowledge that aspect is a limitation to offer support in a reasonable time.

The three studies have shown there is scope for improvement in the accessibility of MOOCs: to identify and to address these barriers:

- **Identifying barriers.** There is a diverse range of accessibility barriers, and some of them do not depend on disability or technical aspects. The accessibility audit is a holistic tool to help providers to identify barriers by considering aspects related to technical accessibility, user experience, quality and learning design.

- **Addressing barriers**. Previous research has developed legislation, frameworks and services to address accessibility in MOOCs (Anastasopoulos & Baer, 2014; Rodríguez-Ascaso & Boticario, 2015; Sanchez-Gordon & Luján-Mora, 2016c; Singleton & Clark, 2013). However, MOOC providers reported a limited ability to address barriers when MOOCs are being run. Disabled learners indicated different ways they had responded to find ways to cope with accessibility barriers; these workarounds though were far from the desired solutions. The accessibility audit facilitates discussion to address barriers from those identified.

To make MOOCs more accessible it is necessary to put in place processes to identify barriers, to strengthen mechanisms that involve the participation of learners in MOOC design (Iniesto & Rodrigo, 2018), and to facilitate agile responses in addressing barriers.

9.4 Implications of the research

Providers understand the importance of research to better know their learners and their needs (Walker, 2018). Guides for developing accessible online learning resources have been produced (Amado-Salvatierra & Hilera, 2015; Moreno et al., 2014; Sánchez, 2013) and previous suggestions to increase accessibility in particular aspects of MOOCs have been reported (Bain et al., 2013; Cinquin et al., 2018; González & Rodríguez, 2016; Ngubane-Mokiwa, 2016; Rodrigo, 2014; Sanchez-Gordon & Luján-Mora, 2015a; Xiao et al., 2015). Ferguson, Herodotou, Coughlan, Scanlon, & Sharples (2018) describe a set of eight priority areas for MOOC development one of which is "*wide access*" built on accessibility and including those learners who are excluded from education. This research project has reinforced the argument that to achieve wide access other areas proposed by the authors need to be achieved, such as: *"develop appropriate pedagogies"*, "*develop effective learning designs*", "*clarify learner expectations*", "*develop educator teams*" (in accessibility) and "*develop new approaches to assessment and accreditation*". A holistic approach to increasing accessibility in those areas will help widen access to all learners.

Following a pragmatic approach, the methodology had three studies (**Section 3.3**). These studies have been run at various stages in the research and developed alongside one another, providing greater knowledge at each stage of the research to answer the three research questions. The strength of the methodology is shown with the MOOC structure developed in **Section 2.5** that has been used for the thematic analysis of the interviews with both MOOC providers and disabled learners. The same structure then guided the design of the walkthroughs in the UX component of the accessibility audit and underpinned the triangulation of the studies in **Section 9.2**. Soundness in the methodology includes the personas used in the audit, which were developed from the disabled learners interviewed in Study B (**Section 7.3.3**). Further, the list of platform providers included in **Section 2.5** contains those interviewed in Study A and has been used to guide the sample for the audit implementation in Study C.

The research findings increase knowledge of the accessibility in MOOCs. The findings provide greater knowledge of the MOOC stakeholders and their commitment to accessibility, such as how MOOCs providers cater for disabled learners and the motivation disabled learners have when taking part in MOOCs. MOOC providers have detailed their internal accessibility processes and shared their understanding of disabled

learners participating in MOOCs. This research provides a better knowledge of disabled learners demographics, motivations, the accessibility barriers they find; how they respond to them; and how they want them to be solved. The accessibility audit has helped to identify and structure accessibility barriers, and the audit has been proved as a valid tool for MOOC providers to be used to identify and develop processes to address accessibility.

The beneficiaries of this research are the stakeholders. First the MOOC providers, who can use the MOOC accessibility audit within their platform and course development processes. Second, learners who will benefit from the greater profile for accessibility and any improvements made to address shortcomings. Providers interviewed in Study A will be contacted to share with them the research findings and the accessibility audit to discuss its applicability and further research to develop accessibility guidelines.

9.5 Limitations of the research

There are limitations in each of the studies in this research project. The pragmatic approach of this research has limitations. Even after including a broad range of user-profiles, disabilities and subject-areas in the samples, some voices may still have been under-represented, as acknowledged in **Section 3.3**.

As outlined in **Section 4.3,** one of the limitations of Study A is self-serving bias in how MOOC providers report the management of accessibility (Libby & Rennekamp, 2012). In this study, some voices are not represented. For example, within the list of platform providers (**Section 2.5**) there are providers missing in the sample which have significant number of learners around the world outside the English-speaking context: Asian platforms (in China and India) and European platforms (in France, Germany and Spain) that would have added a more global perspective to the research. The study has not included facilitators who look after the forums, address queries and have a day to day insight into the pedagogy and dynamics of collaboration in MOOCs (Beaven et al., 2014). Study A has not included MOOC researchers, such as those conducted research in CPD via MOOCs (Calonge & Shah, 2016). There is also an over-representation of the OU and FL affiliated participants in the sample. This limitation does not affect the interview perspective of answering the research questions, as those are not directly linked to the MOOC providers' affiliations but to their individual experiences with MOOCs (**Section 4.4.2**).

In Study B, one limitation is the use of data from surveys that were not designed for this research. Quantitative data was taken from MOOC surveys with limited response rates compared to similar studies (Liyanagunawardena & Williams, 2016), as reported in **Section 5.5.** Responses were analysed based on a disability marker limiting its applicability to answer the research questions (Richardson, 2017), in that sense surveys were designed with a lack of constraints and constructs limiting the scope for clustering of responses and identification of correlation factors in terms of how gender, age, and location influence disabilities. MOOCs learners who fill in the post-course survey may show biased satisfaction since they have finished the MOOC (Pursel et al., 2016). In designing the learner interviews the original intention was to invite up to 20 disabled learners. The final set of 15 disabled learners interviewed were considered representative for the study due to the richness and diversity of their answers. However, it is acknowledged that the sample has limited capacity to represent a broad range of disability groups and diversity in society. Different

recruiting criteria could have been used to complement the sample, for example to improve equality in gender and younger learners. Criteria used to sample in the study design also implied interviewing experienced MOOC learners and who had completed the courses over voices of unsuccessful learners (**Section 6.3.2**).

In Study C, the sample was limited to four MOOC platforms. However, these cannot represent all MOOC platforms (**Section 8.2.2).** Limitations of each individual component of the audit are discussed in **Sections 8.3.2 - 8.3.5**.

9.6 Future research

In line with the need for having holistic approach of embracing accessibility in MOOCs discussed in Rodríguez-Ascaso & Boticario (2015) and Rodrigo & Iniesto (2015) and introduced in **section 2.9,** contributions from this doctoral research can lead to different areas for further research. Future research related to the accessibility of MOOCs needs to consider technical and pedagogical aspects and the participatory approaches of including both MOOC providers and learners.

The empirical research with learners could be extended in several ways to build on the limited comparison possible from secondary surveys and some selected interviews. Future work could use control groups in a comparative study by interviewing learners participating in MOOCs and including both non-disabled and disabled learners in the sample. Another extension would be to focus on case studies with particular disabilities to understand their needs in-depth (Richardson, 2017). Such an approach would avoid medical models of clustering disabled learners and allow a *"putting people and processes first"* perspective (Cooper et al., 2012).

In this research taking a Person-Centred Planning (PCP) approach has facilitated the interviewing process. Future interviews should be designed to cover known accessibility barriers and to discuss learners' solutions by following the MOOCs structure outlined in **Section 2.5**. Possible other sources of data may also be considered such as surveys included in accessibility-related MOOCs and analysis of the activity data of learners participating in MOOCs (Cooper et al. 2016).

The thesis adopted the use of UDL in the audit. UDL has been proved as a useful framework to categorise accessibility barriers (Griful-Freixenet et al., 2017; Iniesto & Rodrigo, 2018). Applying UDL may be an appropriate framework for future analysis to address accessibility barriers.

The audit has been validated and piloted through the implementation described in this thesis (Chapters 7 and 8). Future work on the audit should introduce the improvements outlined in **Sections 8.3.2 to 8.3.5**. New regulations on the accessibility of websites and mobile applications of public sector bodies also need to be considered[81] including updated standards such as WCAG 2.1[82] to keep the audit tool up-to-date. The next steps could be to refine the audit tool and streamline the process of the audit which identifies overlaps

[81] The Public Sector Bodies Accessibility Regulations 2018, http://www.legislation.gov.uk/uksi/2018/952/contents/made
[82] WCAG 2.1, https://www.w3.org/TR/WCAG21/

(i.e. those criteria which produce similar results and have a similar specification) and remove criteria that do not help identify accessibility barriers. The audit needs to be further tested in for a greater variety of MOOC platforms, and for several MOOCs per platform in order to evaluate the differences between MOOCs from different course providers being run in the same platform. There is also an opportunity for additional analysis to cluster the findings form the audit (Study C) by themes from those derived in the interviews with the learners (Study B), such as *"The MOOC structure"*, *"Technical vs Learning Design"*, and *"Disability vs Non-disability related"*.

The audit could also be extended to include components that address other accessibility assessment perspectives, for example evaluating authoring tools which are used by course providers to produce and upload educational resources, following Authoring Tool Accessibility Guidelines[83] (ATAG) (**Section 3.6**) (Sanchez-Gordon & Luján-Mora, 2016c; Sanderson et al., 2016). Future research needs to consider the accessibility limitations of authoring tools and the relationship of the tools with pedagogy in MOOCs (Seale & Cooper, 2010). Stakeholders should be included in future research: such as, interviewing MOOC providers and experts to determine the usefulness of the audit in their organisations and engaging learners to participate in end-user evaluations.

Future research could involve development of guidelines to support audit evaluations during the MOOC design and development processes (for platforms and educational resources) rather than when MOOCs are run. These guidelines can be framed in the process model for the MOOC design (Pike & Gore, 2018). It should be feasible to develop guidelines linked to the accessibility audit that evaluate MOOCs following the same checklist structure proposed for the audit (**Section 7.3**). The next steps would be to link processes to the guidelines so that if there is a problem that affects different disabled learners in any process, the guidelines could indicate the approach to follow. To help achieve such guidelines which are (and should be) continuously getting added to and developed to meet learner needs, participatory research methods of involving learners in the design processes should be considered (Knox, Mok, & Parmenter, 2000).

The stakeholders have shown an interest in applying profiling options in MOOCs. In **Section 2.6,** proposals to increase accessibility included the production of software layers to profile leaners, as in the case of Open edX (Sanchez-Gordon & Luján-Mora, 2015b). As Ferguson, Sharples, & Beale (2015) suggest that MOOCs need to evolve to meet societal needs building on advances in technology, and so future research should continue developing accessibility profiling standards and their practical applications in open education (Navarrete & Luján-Mora, 2018). Research in applying profiling to accessibility should also connect to existing projects which are researching profiling options and their applicability in OER such as GPII[84] (Vanderheiden et al., 2014). As well as continuously gathering feedback from learners, the requirements of learners evolve and, also, with the technological changes, there will be accessibility barriers which the learners may not have encountered before. Obtaining feedback from learners favours MOOC providers to

[83] ATAG, https://www.w3.org/WAI/standards-guidelines/atag/
[84] GPII One-size-fits-one Digital Inclusion, https://gpii.net/

adapt the platform designs and educational resources to meet the accessibility requirements of learners, that is the main functionality of the project YourMOOC4all[85] (Iniesto & Rodrigo, 2018). Further research could also consider the role of learning analytics in addressing accessibility in MOOCs (Cooper et al., 2016) and aspects such as how learner-emotions affect learning (Hillaire et al., 2017).

Finally, MOOC providers should consider the limitations and difficulties in developing skills in accessibility (Lewthwaite & Sloan, 2016). Analytical papers included in **Section 2.6** under the heading *"MOOCs as an approach to teaching accessibility"* can be a source of knowledge to train the course teams.

9.7 Concluding remarks

This research has yielded an understanding of how MOOC providers cater for disabled learners, the motivations of disabled learners when taking part in MOOCs, and how MOOCs should be designed to be accessible for disabled learners. A range of barriers to accessibility in MOOCs have been identified, and an accessibility audit for MOOCs has been proposed. In that sense, this research has shown that even though there are inherent challenges in massiveness, MOOC providers should seek a better understanding of their learners and their needs. The interests of disabled learners are varied and findings from previous research have not been focused on accessibility. MOOC development processes need to be updated to produce more accessible MOOCs from the early design stages, with an important change in focus from legislation to actually meeting learners' needs.

This thesis has developed a better knowledge of stakeholders' perspectives from both the producer and learner communities and produced an accessibility audit to help to build processes for MOOC providers to produce more accessible MOOCs. These processes should follow an inclusive design (ID) approach matched to the massive and open context to increase accessibility for a wide range of disabilities and enhance access to different target groups. Some potential solutions to barriers have also been identified, such as developing content that provides multiple format educational resources and acknowledging the need to support personalisation of learning experience in MOOCs.

The vision in this thesis is that the MOOCs of the future will have more accessible platforms and courses. Towards this vision, MOOCs need to include a range of accessible educational resources and offer options for learners to set their own goals. They should give clear guidance to facilitate collaboration in discussions and assignments, provide feedback in quizzes, and operate better processes to give help. To achieve this vision, personalisation options will be required; that way MOOC learners can adapt their learning environments to their individual needs.

[85] YourMOOC4all, http://yourmooc4all.lsi.uned.es/

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Glossary

Accessibility. Page 26.

Audit. An accessibility audit is an evaluation of how well a product supports the needs of web disabled users with disabilities, carried out by expert accessibility consultants and disabled people[86].

Cognitive walkthroughs. Page 51.

Course providers. Page 32.

Differentiated instruction. Page 52.

Disability. Page 26.

Goal-directed persona. Page 51.

Heuristic evaluation. Page 131.

Inclusive Design. Page 27.

Open Educational Resource (OER). OERs are any type of educational materials that are in the public domain or introduced with an open license. The nature of these open materials means that anyone can legally and freely copy, use, adapt and re-share them. OERs range from textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audio, video and animation[87].

Openness. Page 30.

Peer to peer (P2P). Peer to peer assignments in MOOCs are those assignments that require another learner (peer) to review the learner's submitted task. The learner who submits the task is expected to review other learners' submission.

Massiveness. Page 31.

MOOC. Page 31.

MOOC aggregator. Websites which include information about several MOOC (course and platform) providers, allowing to search MOOCs by different topics and subjects, once a MOOC is selected, the learner is redirected to the MOOC platform provider website to start the selected MOOC.

MOOC Learners. Page 32.

[86] Accessibility audit, https://www.interactiveaccessibility.com/services/accessibility-audit
[87] UNESCO, https://en.unesco.org/themes/ict-education/oer

MOOC providers. Page 32.

Open access (OA) licenses and standards. Licences and standards which grant access under copy left restrictions to reuse and\or adapt the content guaranteeing authorships[88].

Open Source Software (OSS). Open-source software is a type of computer software whose source code is released under a license in which the copyright holder grants users the rights to study, change, and distribute the software to anyone and for any purpose[89].

Platform providers. Page 32.

Pragmatism. Page 44.

Universal Design for Learning. Page 54.

Usability. Page 26.

[88] Open Access, https://en.wikipedia.org/wiki/Open_access
[89] Open Source Software, https://en.wikipedia.org/wiki/Open-source_software

Appendix 1: Study A and B. Project Summary Sheet

Who am I?

I am a PhD research student at the Open University, UK and in the Institute of Educational Technology.

What do I want to know?

Study A

In my research project, I will involve various stakeholders who are working on MOOC platforms as designers, providers or as accessibility experts. I will carry out empirical investigations with these stakeholders to capture their practices and constraints of integrating accessibility in the design of MOOCs and MOOC platforms.

Study B

I am developing recommendations to improve the accessibility of Massive Open Online Courses (MOOCs). At this point my aim is to understand the point of view from MOOC learners to understand their experiences.

What will it involve?

Study A

A semi-structured interview will take no longer than 45 minutes and will be audio recorded. If you decide to participate, you will be asked to sign a consent form. I have submitted the appropriate ethics procedure to conduct the study from the University's Research Ethics Committee. You maintain the right to withdraw from the study until three months of the interview. Upon your withdrawal from the study, all data collected from you will be deleted and will not be further used in the research.

Study B

You will be requested to:

- Fill out an online questionnaire. This will take less than 10 minutes
- Take part in a semi-structured interview. This will take no longer than 30 minutes.

During the interview you can pause and resume the discussion as you wish. You also have the right to terminate the interview at any time without giving a reason for doing so. You can withdraw from the study without explanation or prejudice.

You have the right to request the destruction of any data gathered by the researcher from you, until it is anonymised. This will take place three months after the date of the interview.

In case of any distress you can request help from the following suggested support services: Samaritans and SupportLine.

If you decide to participate you will be asked to sign a consent form.

If you take part in a full-length interview, you will be sent a £10 Amazon gift card on completion of the interview.

This research has been approved by The Open University's Human Research Ethics Committee (HREC/2017/2451/Iniesto).

What will I do with the information I collect?

I will keep all the information (recordings and notes) secure and as per the Data Protection Act. Only my supervisors and I will have access to this raw material.

Anonymous quotes from the interview and excerpts from the questionnaire responses may then be published in my PhD thesis and in scientific publications and presentations. These will not be personally identifiable.

How can you contact me or my supervisors?

Questions should be directed to Francisco, concerns about the project may be directed to any supervisor.

Contact information removed

Appendix 2: Study A and B. Consent form

Consent form for persons participating in a research project

Name of participant:

Name of principal investigator(s): Francisco Iniesto

1. I consent to participate in this project, the details of which have been explained to me, and I have been provided with a written project summary sheet in plain language to keep.
2. I understand that my participation will involve an online questionnaire and an interview, and I agree that the researcher may use the results as described in the plain language statement.
3. I acknowledge that:
    a. the possible effects of participating in this research have been explained to my satisfaction;
    b. I have been informed that I am free to withdraw from the project without explanation or prejudice and to request the destruction of any data that have been gathered from me until it is processed. This will take place three months after the date of the interview;
    c. the project is for the purpose of research;
    d. I have been informed that the confidentiality of the information I provide will be safeguarded subject to any legal requirements;
    e. I have been informed that with my consent the data generated will be stored in a password protected computer and will be destroyed after two years following the completion of the PhD;
    f. If necessary, any data from me will be referred to by a pseudonym in any publications arising from the research;
    g. I have been informed that a summary copy of the research findings will be forwarded to me, should I request this.

I want the interview to be in the following format:

Study A

I consent to this interview being audio-taped

□ **yes** □ **no** (please tick)

Study B

I want the interview to be in the following format:

□ **Audio. I consent to the interview being audio-taped** □ **Text. Using a chat tool** (please tick)

I wish to receive a copy of the summary project report on research findings

□ **yes** □ **no** (please tick)

Participant signature: Date:

Appendix 3: Study A. Interview Template

At this stage, I aim to understand the point of view from platform providers, course providers and MOOC researchers concerning accessibility. A semi-structured interview will take no longer than 45 minutes and will be audio recorded.

*Intro and warm up questions **5 min***

1. *Remind that the interview will be recorded*
2. *Introduce myself and my research.*
3. *Interviewer and his profile. The project he is working in*.

Theme 1: Data availability and knowledge about disabled learners. 10 min

[Prompt]

1. Why disabled learners could be interested in MOOCs?

[Prompt]

2. Do you have data on disabled learners using your platform\MOOCs?

    [Prompt]

    a. Are you tracking disabled learners, e.g. through surveys or via a profile during the registration process?

[Optional]

3. If so, have you found data that shows why disabled users can be interested in MOOCs?

Theme 2: Daily work: MOOC providers dealing with accessibility. 15 min

[Prompt]

1. What protocol is performed to receive the courses from the teaching staff regarding accessibility?

    [Prompt]

    a. Are implicitly topics related to accessibility included in the guidelines delivered to the teaching teams?

    b. Is being used any template that includes accessibility for PowerPoint, Word or PDF files?

    c. How do you work on accessibility in the production of video-lessons? (subtitles, audio description, transcriptions)

d. Are you taking into account how the learning design could improve accessibility?

e. Are there any concrete guidelines to follow regarding accessibility? Any legal obligation? (standards)

[Prompt]

2. What is the platform accessibility status?

    a. What engine are you using in the platform?

    b. Do you know how this engine works regarding accessibility?

    c. Has been added any accessibility functionalities to the original engine?

    d. Has been performed any accessibility audit for the platform or courses?

[Optional]

3. How would you improve the current accessibility state of the platform and MOOCs?

Theme 3: MOOCs and adaptation. 10 min

[Prompt]

1. How is metadata being treated in the platform?

    a. How is MOOCs information shared to offer public information about the courses?

[Prompt]

2. How could MOOCs be modified depending on learner needs to improve their accessibility and usability?

[Prompt]

3. In which way could be useful in a MOOC to inform the learner of the accessibility status the course has?

    [Prompt]

    a. What may be helpful for a learner to see in the MOOC that can indicate to him it is accessible?

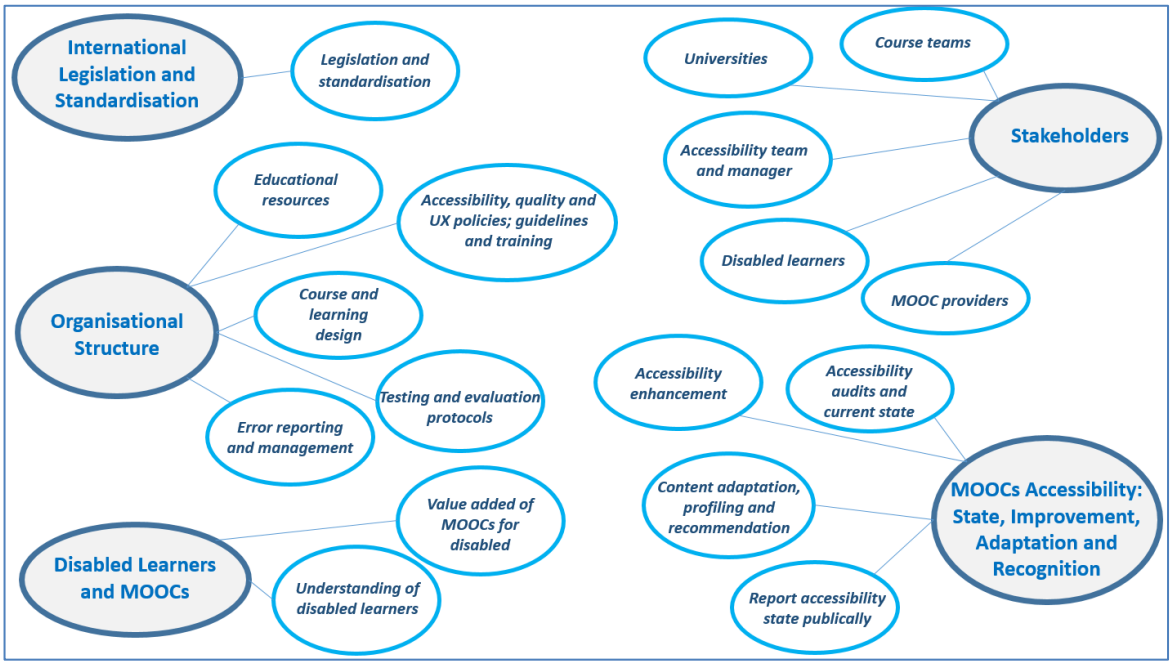
    [Optional]

    b. There are no standards or iconography to display this data. How would you improve that?

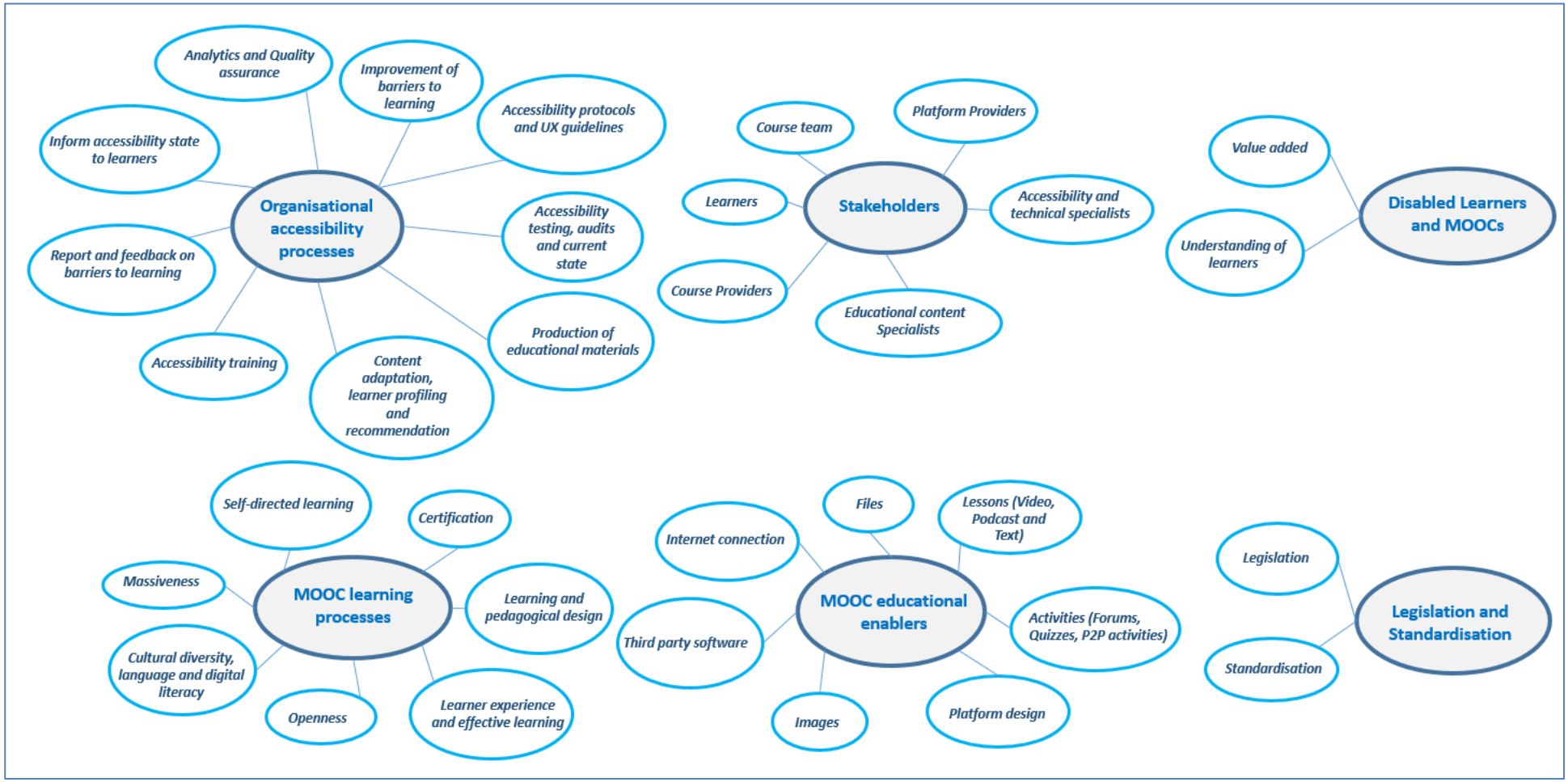
[Optional]

4. Why could disabled learners be recommended to choose which MOOC is more accessible? For example the possibility to choose among several MOOCs which one is more accessible.

Appendix 4: Study A. Thematic map



Thematic map representing the themes and sub-themes at the first iteration



Thematic map representing the themes and sub-themes at the second iteration

Appendix 5: Study B. Survey questions

Pre-course

A. Demographic information

1. What is your gender? (selection list)

Male. Female.

2. What is your age? (selection list)

Under 16 years. 16-18 years. 19-25 years. 26-35 years. 36-45 years. 46-55 years. 56-65 years. Over 65 years.

3. Which country do you live in? (selection list)

UK \ overseas (grouped)

4. What is your first spoken language? (selection list)

English \ Non-English (grouped)

5. What is your highest educational qualification? (selection list)

No formal qualification. School-leaving qualification (16 years). School-leaving qualification (18 years). Vocational qualification. College diploma. Undergraduate. Postgraduate. Doctorate.

6. What is your employment status? (selection list)

Full-time employed. Part-time employed. Full-time voluntary work. Part-time voluntary work. Full-time student. Part-time student. Unwaged and seeking employment. Unwaged with domestic responsibilities. Disabled and not able to work. Retired.

7. Do you consider yourself to have a disability? - If you answered yes to the question above. please indicate the nature of your disability (multiple choice, multiple answer)

Blind or partially sight. Deaf or hard of hearing. Restricted mobility. Restricted manual skills. Impaired speech. Dyslexia or other specific learning difficulties. Mental health difficulties. Personal care support. Fatigue or pain. Unseen disabilities. Autistic spectrum disorder.

B. Location

8. *Where do you expect to do the course? (multiple choice, multiple answer)*

   At work. At school / college / university. At home. In a public place. While on the move.

C. Areas of interest and previous experience

9. Why are you interested in studying this course? (multiple choice, multiple answer)

Personal interest. Professional development. Relevant to my work. Relevant to my current studies. To prepare me for future study. For the purpose of teaching others. For the purpose of sharing with others. Relevant to voluntary work. To improve my English. To find out if I can study at this level. To find out more about MOOCs. The course was free. To try out learning online. To learn more flexibly around my other commitments.

10. What sort of online course have you taken? (multiple choice, multiple answer)

An online course for continuing professional development. A MOOC. An online course for university credit. An online course based around OER.

11. Have you studied an open course with any of these providers? (multiple choice, multiple answer)

BBC Learning. Coursera. edX. FutureLearn (other than this course). iTunesU. Khan Academy. MIT. OpenCourseWare. Open Yale Courses. OpenLearn. TED. Udacity.

Post-course

A. Devices

1. Which devices did you use to study the course? (main device, other device, not used) (multiple choice, single answer)

Tablet. Desktop computer. Smartphone. Laptop.

B. Previous knowledge and motivation

2. How much did you know about the subject of this course when you started? (multiple choice, multiple answer)

Little or nothing. Some experience. I have taken another free online course in this area. I have a school-level qualification in this area. I have a university-level qualification in this area. I work in this area or have worked in this area. I am an expert in this area. I teach in this area or have taught in this area.

3. Which phrase best describes your approach to the course? (selection list)

I was highly motivated. I was motivated. I was motivated some of the time. I struggled to stay motivated. I wasn't really motivated.

C. Completion

4. *People work through open courses in different ways. Which of these is most like what you did? (selection list)*

I signed up, but didn't get much further. I did a lot in the first week, but not much after that. I had a quick look at everything. I worked through some sections in detail. I worked through one section in detail. I watched what was going on, but didn't actively participate. I worked all the way through the course and did most of the course.

5. *If you did not take part in the entire course, why was that? (multiple choice, multiple answer)*

I didn't have enough time. I lost interest / motivation. I didn't keep up as the course progressed. I found the site hard to use. I'm not used to learning at this level. The course was too advanced. The course was too basic. I couldn't access the course materials. I didn't have a good enough Internet connection. I never really intended to take part – I was just curious. I never really intended to take part – I joined the course by mistake. I was suffering from ill-health. There was not enough staff support. The course did not meet my learning goals.

D. MOOC design

6. *How did you feel about the amount of time required by the course? (selection list)*

The course was too advanced. The course was too basic. Far too much. A bit too much. About right. A bit too little. Much too little.

7. *How clear did you find the structure of the course? (selection list)*

I'm not used to learning at this level. Very clear. Fairly clear. Neither clear nor unclear. Fairly unclear. Very unclear.

8. *Please select words from the list below that describe the online discussions on the course (multiple choice, multiple answer)*

Interesting. Helpful. Scary. Off-putting. Confusing. Encouraging. Important. Boring. Irrelevant. Difficult. Stimulating. Too long. Too short. Thought-provoking. Challenging. Changed my view.

9. *Please select words from the list below that describe the things you were asked to do on this course (multiple choice, multiple answer)*

Interesting. Helpful. Scary. Off-putting. Confusing. Encouraging. Important. Boring. Irrelevant. Difficult. Stimulating. Too long. Too short. Thought-provoking. Challenging. Changed my view.

E. Learning experience

10. *Please rate from "strongly disliked" to "strongly liked" how you felt about the different ways of learning on FutureLearn (scale, Likert)*

Reading articles. Watching videos. Reading comments posted by other learners. Discussing things online with other learners. Doing quizzes and tests and getting feedback. Following links to other related content.

11. Please indicate the extent to which you agree with these statements (scale, Likert)

I enjoyed studying. The course was intellectually stimulating. The quality of the teaching materials was good. The course met my expectations. I found the feedback helpful. I was able to keep up with the workload. Overall the quality of this course was good. I would recommend this course to others. This course made me want to study more.

12. To what extent did FutureLearn meet your expectations in terms of the following? (scale, Likert)

Supplementing my existing studies. Interacting with other people. Adding a fresh perspective to my current role. Learning new things. Preparing for further studies. Learning more flexibly around my other commitments. Improving my career prospects. My overall expectations of the course.

13. Which of the following statements about your subject knowledge best applies to you? (selection list)

I know a lot more about this subject now. I know a little more about this subject now. My knowledge of this subject has not changed.

14. Thinking about your experience on other open online courses (or MOOCs). Which of the following statements about your learning best applies to you? (selection list)

I learned more this time. I learned less this time. I learned about the same amount this time. I have studied several of these courses and usually learn more. I have studied several of these courses and usually learn less. I did not learn anything from these courses. I have never studied an open online course or MOOC before.

F. *Course team*

15. Thinking about your experience on other open online courses (or MOOCs), which of these statements about the support from staff on this course best applies to you? (selection list)

Staff support was better this time. Staff support was worse this time. Staff support was similar every time. I have studied several courses like this, and staff support is usually better than it was in this course. I have studied several courses like this, and staff support is usually worse than it was in this course. I received no staff support. I have never studied an open online course or MOOC before.

16. This course had Facilitators to help learners. (multiple choice, multiple answer)

The Facilitators were very active on the course. I did not notice the Facilitators. The Facilitators responded to posts. The Facilitators confused me. The Facilitators removed inappropriate posts. Facilitators were not there when they were needed. The Facilitators posted helpful messages. The Facilitators should have done more. The Facilitators provided useful links. The Facilitators shared information about Open University

courses. I was very satisfied with the Facilitators. The Facilitators were satisfactory. The Facilitators were not good. It would have been useful to have support from previous students.

G. Overall evaluation and future actions

17. How would you rate your overall experience on this FutureLearn course? (Scale, Likert)

Excellent. Good. OK. Poor. Very poor.

18. As a result of using this Open University course are you more or less likely to do the following? (multiple choice, single answer)

Pursue employment or a career in this area or a related field. Take another free course in this subject area. Take a paid-for course in this subject area. Research this subject further. Take part in other online activities. Look at other related materials. Visit related museums. Meet with other interested people offline. Study more free Open University materials. Make use of Open University materials for teaching. Recommend Open University materials to others.

Appendix 6: Study B. Letter to contact learners

Opportunity to take part in a research interview from the Open University

Dear Name,

Thank you, for your participation in the MOOC: "MOOC name" from The Open University at FutureLearn.

My name is Francisco Iniesto and I am a PhD researcher in Institute of Educational Technology (IET) of The Open University. My research topic is the accessibility of MOOCs and how this can be improved. The research will be of benefit to learners with accessibility needs and will guide MOOC providers to improve their approaches to accessibility. You can find attached the "Project summary" where my research project is explained in more detail.

You acknowledged during a course survey you would be interested in taking part in a research interview. As such, I am writing to ask if you would be willing to participate in my research. You would be asked to:

- Fill out an online questionnaire. This will take less than 10 minutes
- Take part in a semi-structured interview. This will take no longer than 30 minutes.

If you take part in a full-length interview, you will be sent a £10 Amazon gift card on completion of the interview.

If you would like to take part, or if you have any questions, please do get in touch using the contact information below.

Thank you very much and best regards,

Francisco Iniesto

PhD Research Student - Open World Learning

T: +44(0)1908332473 –francisco.iniesto@open.ac.uk

Institute of Educational Technology – The Open University

Appendix 7: Study B. Pre-interview questionnaire template

Theme 1: General questions

[Prompt]

1. Why were you interested in participating in a MOOC?

[Prompt]

2. What different MOOC providers have you taken courses with? (multiple choice)

   Coursera, Udemy, edX, Futurelearn, Udacity, MiríadaX, NovoEd, Canvas, Open2Study, Iversity, OpenCourseWorld, Lagunita \ Stanford Online, Khan Academy, Others

[Prompt]

3. How many MOOCs from different providers have you participated in total?

[Prompt]

4. Please list them if you can

[Prompt]

5. Do you use any assistive technology or software to access the MOOCs? If yes, what do you use?

Theme 2: Accessibility barriers

[Prompt]

6. Can you think of situations where you found it difficult to carry on with the MOOCs themselves? Please explain them?

   [Prompt]

   a. Did you continue with the MOOCs? If yes, what did you do in response to the problems?

   [Prompt]

   b. Can you think of anything that would have made it easier to resolve these situations?

Appendix 8: Study B. Interview template

At this stage, I aim to understand the point of view of learners. A semi-structured interview will take no longer than 30 minutes.

*Intro and warm up questions **5 min***

1. Remind that the interview will be recorded
2. To introduce my research.
3. Interviewer's profile.

Theme 1: Accessibility and daily work: current state and improvements. 15 min

Considering the pre-interview questionnaire, dynamic questions depending on the responses.

[Prompt]

7. The situation of interacting with a MOOC where you found it difficult to carry on. Elaborate on the situation that the learner has already outlined in the pre-interview questionnaire.

    [Optional]

    a. Dynamic questions related to the issue reported in the pre-interview questionnaire

[Prompt]

8. Have you had any other situation of interacting with a MOOC where you found it difficult to carry on? Please explain it

    [Prompt]

    a. What did you do in response to the problem?

    [Prompt]

    b. What were the consequences? To continue or finishing the course?

    [Prompt]

    c. How did you react to the problem the next time it occurred? What did you do differently in response to the problem?

    [Optional]

    d. Did you have to request additional support? To whom? (e.g. other students, family, facilitators, administrative staff)

[Prompt]

9. Tell me about your experience accessing the platform

a. What kind of problems did you find while accessing the platform and the course? (E.g. the login page, the forums to add comments).

[Prompt]

b. What kind of problems did you find while accessing the video-lessons? (subtitles, audio description, transcriptions)

[Prompt]

c. What kind of problems did you find while accessing documents such as PowerPoint, Word or PDF documents?

[Prompt]

10. Tell me how you felt while participating in the activities

[Prompt]

a. Which problems did you find while participating in the activities? (E.g. understanding what I was expected to do, participating with other learners)

[Optional]

b. Did you enjoy participating in activities with other learners? Participating in their discussions? If not, why?

[Optional]

c. What about the tests and feedback from activities (peer to peer)?

[Prompt]

11. How would you improve the accessibility considering the problems described?

Theme 2: Learners' motivations when participating in MOOCs. 10 min

Considering the pre-interview questionnaire, dynamic questions depending on the responses.

[Prompt]

12. What were your expectations when participating in the MOOC?

[Prompt]

a. Did then the MOOC fulfil your expectations?

[Optional]

b. Was finishing the MOOC your goal? If not, which one it was?

[Optional]

c. What did you gain from the MOOCs even if you did not finish them?

[Optional]

13. Why are free MOOCs important for you? Has this influenced you to participate in them?

[Prompt]

14. Have you got a certificate from the MOOC to be included in your CV?

[Optional]

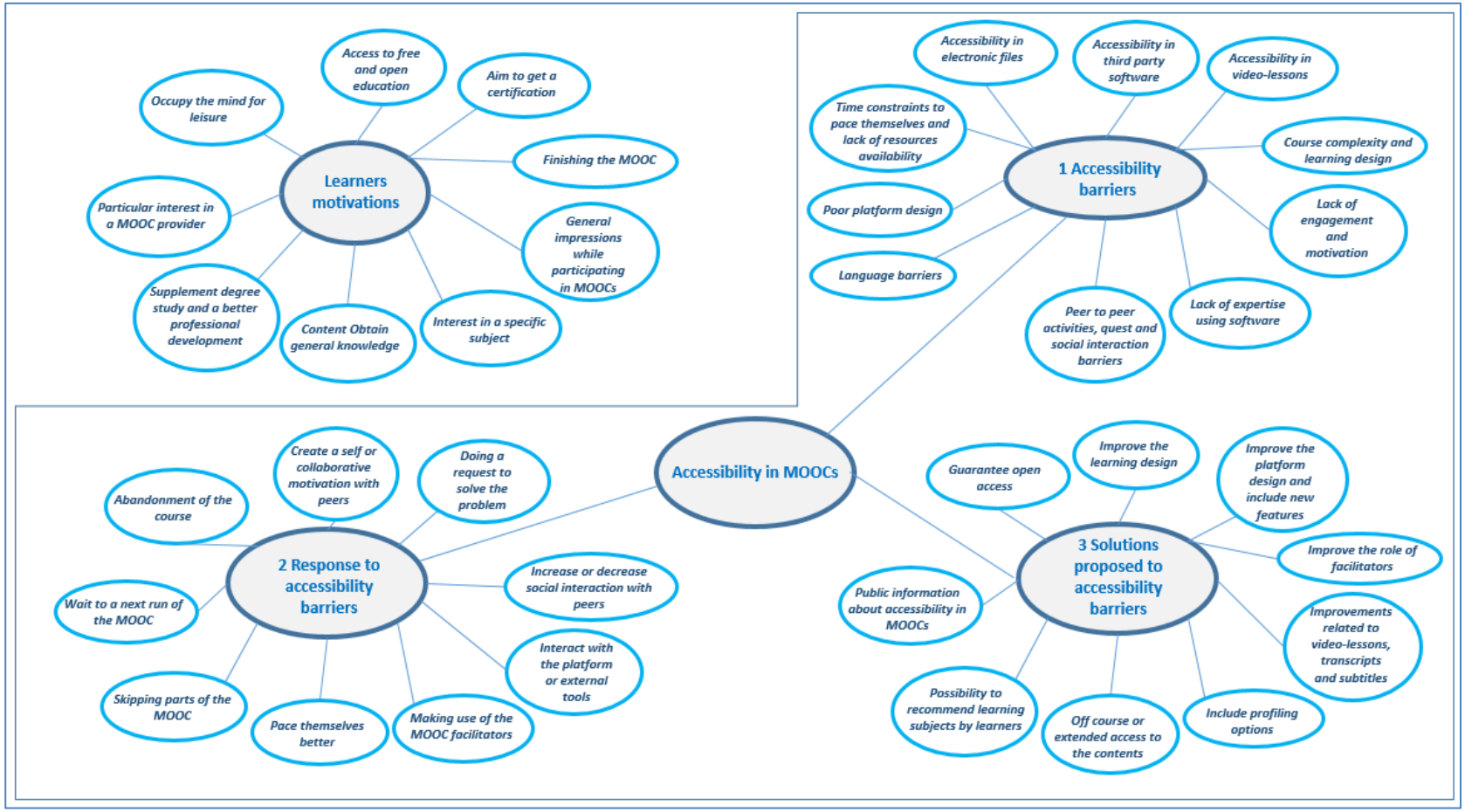
a. In which sense do you think a certification from a MOOC could help you or other learners?

Theme 3: MOOCs and adaptation. 5 min

15. In which way, could be useful in a MOOC to inform the user of the accessibility status the course has?

16. What may be useful for you to see in a MOOC that can indicate it is accessible?

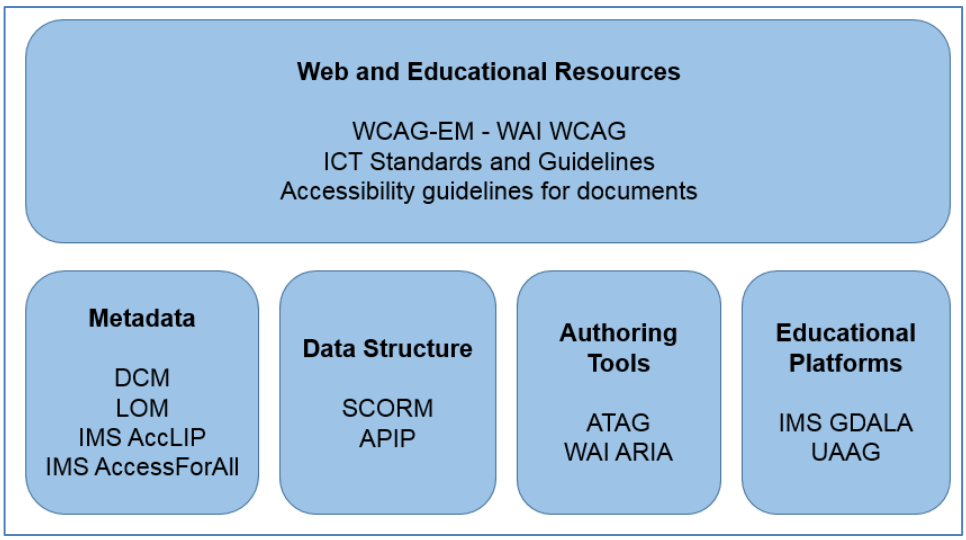
Appendix 9: Study B. Thematic map



Thematic map representing the themes, sub-themes and codes at the first iteration

Appendix 10: Study C. Review of accessibility standards

The principal groups of standards are divided into five main groups: educational resources, metadata, data structure, authoring tools and educational platforms.



Groups of educational related accessibility standards updated from (Iniesto & Rodrigo, 2013)

The web and educational resources include standards that cover multiple areas:

- **Website Accessibility Conformance Evaluation Methodology** [90] (WCAG-EM, 2014). It describes a procedure to evaluate websites and includes considerations to guide evaluators and to promote good practice. The Web Accessibility Initiative[91] (WAI) provides general guidelines for generating accessible content WCAG 2.0[92] (2008) and WCAG 2.1[93] (2018).

- **Information and Communication Technology (ICT) Standards and Guidelines** (2018)[94]. Revised Section 508[95] of the Rehabilitation Act (2018) and revised version of the Section 255 Guidelines for Information and Communication Technology (2017)[96].

- **Accessibility guidelines for documents.** Standards for the creation of accessible educational content which include text-based documents with Word, PDF[97] (2014) or EPUB[98] (2017); Flash embedded content, SVG for vectors or mathematical content with MathML.

[90] WCAG-EM, https://www.w3.org/TR/WCAG-EM/
[91] WAI, https://www.w3.org/WAI/
[92] WCAG 2.0, https://www.w3.org/TR/WCAG20/
[93] WCAG 2.1, https://www.w3.org/TR/WCAG21/
[94] ICT Standards and Guidelines, https://www.access-board.gov/guidelines-and-standards/communications-and-it/about-the-ict-refresh/final-rule
[95] Section 508, https://www.section508.gov/manage/laws-and-policies/quick-reference-guide
[96] Section 255, https://www.access-board.gov/guidelines-and-standards/communications-and-it/about-the-ict-refresh/overview-of-the-final-rule
[97] PDF Techniques for WCAG 2.0, https://www.w3.org/TR/WCAG-TECHS/pdf.html
[98] EPUB Accessibility 1.0, https://www.w3.org/Submission/2017/SUBM-epub-a11y-20170125/

In the case of metadata, they represent the consistent description of the resources among applications. To activate the search and reuse of the educational resource:

- **The Dublin Core metadata** [99] (DCM, 2012). It refers to digital objects of general information.
- **Learning Object Metadata**[100] (LOM, 2002). The standard for learning objects is a conceptual data schema that defines the structure of a metadata instance for a learning object.
- **IMS standards**. AccLIP[101] (2004) AccessForAll [102] (2012) are composed of the associated metadata that describes the accessibility properties of the learning contents and the adaptations of the resources.

In the case of the organisation and structure of the data, the interoperability standards of distributed systems are applicable in this case:

- **Sharable Content Object Reference Model** [103] (SCORM, 2008). It is a specific model for the exchange of learning object. The ultimate goal is not to compete with other standards, but to gather them all together.
- **Accessible Portable Item Protocol**[104] (APIP, 2014). It provides assessment programs and question item developers with a data model for standardising the interchange file format for digital test items.

Authoring tools are responsible for creating online educational resources, to allow LMSs manage such resources they need to ensure is accessible:

- **Authoring Tool Accessibility Guidelines**[105] (ATAG, 2012). It is focused on producing accessible online educational material closely related to the WCAG guidelines.
- **Accessible Rich Internet Applications**[106] (ARIA, 2017). It provides semantic information about widgets, structures, and behaviours, to allow assistive technologies to convey appropriate information about a disability.

Educational resources have to show the same behaviour in all environments (different web browsers and devices), LMSs need to have a consistent user interface and be easy to navigate:

- **Guidelines for Developing Accessible Learning Applications**[107] (GDALA, 2004). It offers specific guidelines for the design and development of e-learning applications.
- **User Agent Accessibility Guidelines**[108] (UAAG, 2015). It guides developers in designing user agents that make the web more accessible. User agents include browsers, browser extensions, media players, readers and other applications that render web content.

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[99] Dublin Core, http://dublincore.org/specifications/
[100] LOM, https://ieeexplore.ieee.org/document/1032843/
[101] AccLIP, https://www.imsglobal.org/accessibility/acclipv1p0/imsacclip_infov1p0.html
[102] AccessForAll, https://www.imsglobal.org/accessibility/accmdv1p0/imsaccmd_oviewv1p0.html
[103] ADL/SCORM, https://adlnet.gov/scorm
[104] Accessible Portable Item Protocol, http://www.imsglobal.org/apip/index.html
[105] ATAG, https://www.w3.org/WAI/standards-guidelines/atag/
[106] WAI ARIA, https://www.w3.org/TR/wai-aria-1.1/
[107] IMS GDALA, https://www.imsglobal.org/accessibility/accessiblevers/index.html
[108] UAAG, https://www.w3.org/TR/UAAG20/

Appendix 11: Study C. Guidelines definitions

Accessibility evaluation

WCAG 2.0 guidelines definitions

Principle	Guideline	Definition
Perceivable (22)	1.1 Text Alternatives	Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language
	1.2 Time-based Media	Provide alternatives for time-based media.
	1.3 Adaptable	Create content that can be presented in different ways (for example simpler layout) without losing information or structure.
	1.4 Distinguishable	Make it easier for users to see and hear content including separating foreground from background.
Operable (20)	2.1 Keyboard Accessible	Make all functionality available from a keyboard
	2.2 Enough Time	Provide users enough time to read and use content
	2.3 Seizures	Do not design content in a way that is known to cause seizures
	2.4 Navigable	Provide ways to help users navigate, find content, and determine where they are
Understandable (17)	3.1 Readable	Make text content readable and understandable
	3.2 Predictable	Make Web pages appear and operate in predictable ways
	3.3 Input Assistance	Help users avoid and correct mistakes
Robust (2)	4.1 Compatible	Maximise compatibility with current and future user agents, including assistive technologies.
Text-based files (3)	5 Accessible PDF	Accessibility evaluation of PDF files

Relationship of ISO 14289-1 checkpoints and the accessible PDF criteria

Criteria	ISO 14289-1 -Checkpoint	Definition
5.1 Basic Requirements	• PDF Syntax • Fonts • Content • Embedded Files • Natural Language	Includes basic requirements related to the syntax of the document, the use of the sources, embedded content and use of the language
5.2 Logical Structure	• Structure Elements • Structure Tree • Role Mapping • Alternative • Descriptions	Elements related to the structure of the document, including the tree and the inclusion of descriptions of images, tables and graphs
5.3 Metadata and Settings	• Metadata • Document settings	Information related to document metadata and configuration

User Experience evaluation

UX Guidelines definitions

Principles	Guidelines	Definition
Platform design and access (6)	1. Registration and sign in	When taking part in a MOOC, learners need to register once and sign in every time they want to access the MOOC
	2. Search and navigation	Learners want to find MOOCs on specific topics of their interest
Educational resources (4)	3. Video	Learners are expected to work through educational bits in MOOCs (read articles and watch videos)
	4. Article	
	5. Text-based file	
Discussion, assignments, tests and quizzes (7)	6. Assignment	Learners have to do peer to peer activities in some MOOCs or another kind of assignments that require interaction between peers
	7. Discussion	In MOOCs, learners find spaces to allow discussion among peers
	8. Quiz-Test	Quiz and tests are part of MOOCs, they are oriented to provide feedback on learners' learning process and to get a certification

Principles	Guidelines	Definition
Help: Report and feedback (2)	9. Help	Facilities learners have to contact for help to report an accessibility barrier
MOOC design (4)	10. MOOC experience	MOOC design and syllabus to organise learners workload for the whole MOOC
	11. Week experience	MOOC design and syllabus to organise learners workload week by week

Quality evaluation

Quality guidelines definition

Principle	Guideline	Definition
The MOOC criteria (13)	1.1 Massive	The pedagogical model of the course is such that the resources do not increase significantly as the number of learners increases
	1.2 Open	Open policies around enrolment, access, location, prior knowledge and free cost are ensured
	1.3 Online	All aspects of the course are delivered online
	1.4 Course	The total study time of a MOOC is minimal
	1.5 Full course	A full course experience is offered with the use of educational resources, the interaction between learners, appropriate feedback, a certification and organised syllabus
Quality of the design (30)	2.1 Target group	Various target groups are identified and prior knowledge for them is considered
	2.1 Workload	Workload per week is feasible for learners to work at their own pace
	2.3 Overall goal	The overall goal of the course is described in a few sentences
	2.4 Learning goals	The course presents a limited number of learning goals, aligned with Lifelong Learning, considering coherence and prior knowledge
	2.5 Learning activities	Assignments, levels of difficulty, participation, learning pathways and engagement are considered to aid learners to construct their learning and to communicate it to others
	2.6 Educational resources	A range of educational resources with a license policy, consistency and examples are provided
	2.7 Feedback mechanism	Feedback contemplates aspects such as the scalability, regularity, frequency, announcement of content, synthesis and the use of live-events
	2.8 Assessment	Assessment contemplates the learning goals, plagiarism, provides some kind of badge and indicates progress
Technical platform and support for learners (9)	3.1 Platform	The platform is reliable and supports learning with online tools
	3.2 Support for MOOC learners	Learners have configuration access to profile and social networks. Help using the FAQ, technical and pedagogical guidelines and feedback instructions are provided

Learning design evaluation

Learning design guidelines definition (UDL)

Principle	Guideline	Definition
Provide multiple means of engagement (10)	7. Recruiting interest	Information that does not engage learners' cognition is inaccessible
	8. Sustaining effort and persistence	The learning of skills and strategies require sustained attention and effort
	9. Self-regulation	It is important to design an extrinsic environment so that it can support motivation and engagement
Provide multiple means of representation (12)	1. Perception	Learning is impossible if the information is imperceptible to the learner, and difficult when information is presented in formats that require extraordinary effort or assistance
	2. Language and symbols	Learners vary in their facility with different forms of representation both linguistic and non-linguistic
	3. Comprehension	The purpose is to teach learners how to transform accessible information into useable knowledge
Provide multiple means for action and expression (9)	4. Physical action	A print format provides limited means of navigation or physical interaction
	5. Expression and communication	There is no medium of expression that is equally suited for all learners or for all kinds of communication

Principle	Guideline	Definition
	6. Executive functions	At the highest level of the human capacity to act skilfully are the so-called “executive functions”

Appendix 12: Study C. Technical accessibility evaluation

The methodology to be used will be the Website accessibility conformance evaluation methodology. WCAG-EM using WCAG 2.0 at the level AAA of conformance.

These checklists are based on the benchmark used by the Inclusive Design Research Centre (IDRC) at OCAD University. The benchmark originally focuses on success criteria that are mandated by the AODA (level A and AA), it is adapted to MOOCs and extended to level AAA. As well the evaluation of PDF documents has been added.

The following criteria are part of the audit for MOOCs: 22 Perceivable, 20 Operable, 17 Understandable, 2 Robust and 3 PDF = 64

Sample

8 key web pages:

Platform:

- The platform's homepage.
- The registration\login page
- The courses search engine

MOOC:

- The course homepage
- The coursework schedule
- A course page including video lesson.
- A course page including test or p2p.
- A course page including forum or discussion.

These are the main pages to look at; any other page can be used as well (for example to check several videos in the MOOC)

Text-based:

- PDF self-produced for the MOOC
- PDF with guidelines about technical and pedagogical indications produced by the platform

Tools used for auditing

- Automatic accessibility checker TAW
- Chrome 63.0.3239.132
    - Wave Evaluation Tool (automated accessibility checker)
    - Web Developer Extension
    - Zoom Text Only
    - Contrast checker
    - HeadingsMap

- Firefox 57.0.3
    - Web Developer Extension
- Internet Explorer 11
- HTML validator
- TPG Colour Contrast Analyser and Contrast Checker, Colour Blind Simulator – Color Oracle
- Screen reader: NVDA screen reader (Firefox) or ChromeVox (Chrome)
- PAC3 for PDF

Resources

- Web Content Accessibility Guidelines 2.0
- Using NVDA to evaluate web accessibility
- Using VoiceOver to evaluate web accessibility
- PDF Techniques for WCAG 2.0

Principle 1: Perceivable

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add "Not Applicable" in the comments

Success Criterion	Level	What to test for	Testing method	NA	PA	LA	FA
1.1.1: Non-text Content	A	Do all images, icons, charts, infographics and other visuals have alternative text? **Note:** *the alt text attribute can only be used on <img> elements. Other elements, such as icons, can have an aria-label, aria-labelledby or aria-describedby attribute. These are all valid forms of providing text alternatives to images.* Does the alternative text sufficiently describe images? If the image is decorative, is the alt attribute blank? **Note:** *empty alt text is not allowed on image links (since they cannot be decorative)*	1. Run Wave automated accessibility checker and inspect alt text descriptions 2. Right-click on the image and select 'inspect element". Look for *alt, aria-label, aria-labelledby and aria-describedby* attributes 3. Navigate to images and icons using the screen reader and listen to the descriptions	☐	☐	☐	☐
Comments:							
1.2.1: Audio-only and Video-only (Prerecorded)	A	Does video or podcasts content, have an alternative format, such as a transcript?	Is there a link or attached document that provides an alternative?	☐	☐	☐	☐
Comments:							
1.2.2: Captions (Prerecorded)	A	Do all videos have accurate subtitles?	Check if a subtitle option is available for videos, and listen to a few sample videos to check for accuracy	☐	☐	☐	☐

Success Criterion	Level	What to test for	Testing method	NA	PA	LA	FA
Comments:							
1.2.3: Audio Description or Full-Text Alternative	A	Do videos have text on the screen that is not communicated to the audio track? Does the video have a significant visual narrative (footage that is not decorative)? If yes, is an alternative format provided?	Watch a few sample videos on the MOOC and establish whether an alternative format is required. If yes, check if one is available	☐	☐	☐	☐
Comments:							
1.2.4: Captions (Live)	AA	Are subtitles provided for all live audio content in synchronised media?	Check if a subtitle option is available for all live video content	☐	☐	☐	☐
Comments:							
1.2.5: Audio Description	AA	Do all videos have an accurate audio description?	Check if an audio description option is available for videos, and listen to a few sample videos to check for accuracy	☐	☐	☐	☐
Comments:							
1.2.6 Sign Language	AAA	Do all videos have Sign language interpretation in the spoken language of the video?	Check if a Sign language option is available for videos	☐	☐	☐	☐
Comments:							
1.2.7 Extended Audio Description	AAA	Do all videos have extended audio description? Where pauses in foreground audio are insufficient to allow audio descriptions to convey the sense of the video, extended audio description is provided for all prerecorded video content in synchronised media	1. Check if the videos need extended audio description, the information provided might need the video to be stopped and add extra info to those with visual impartment to understand the presenter 2. Check if the extended audio description is available for videos	☐	☐	☐	☐
Comments:							
1.2.8 Media Alternative	AAA	Is there an alternative for time-based media is provided for all video or podcast media?	This approach involves providing all of the information in the synchronised media (both visual and auditory) in text form. Therefore check there are transcriptions available for the videos or podcasts in the MOOC sample and if they are accurate	☐	☐	☐	☐
Comments:							
1.2.9 Audio-only (Live)	AAA	Is an alternative for time-based media that presents equivalent information for live audio-only content provided	This approach involves providing all of the information in the synchronised media (both visual and auditory) in text form. Therefore check there are transcriptions available for live videos or podcasts and if they are accurate	☐	☐	☐	☐

Success Criterion	Level	What to test for	Testing method	NA	PA	LA	FA
Comments:							
1.3.1: Info and Relationships	A	Does the page contain a proper heading structure? A proper heading structure: • Contains a single h1 level heading per page that identifies the overall page topic • Follows a hierarchical structure • Does not contain empty headings Are tables marked up correctly? Correct table markup: • Defines column and/or row header cells with a <th> tag. • Identifies header scope or links headers with data cells using ids in complex tables. For example, if a table has divided into sections and each section has it's own headers, there is a programmatic association between those headers and the related cells • Is not used for layout. In cases where tables are used for layout, role="presentation" is used so that AT can disregard the table structure Are lists, including navigation items and carousel slides, marked up correctly? Correct list markup • Encases lists in a (unordered list) or (ordered list) tag, with each item tagged as • Does not split lists that are arranged in columns visually into separate lists Are form fields labelled correctly using the <label> tag, aria-label or aria-labelledby attribute? Are related inputs such as groups of checkboxes and radio buttons grouped using a <fieldset> tag and labelled using a <legend> tag? Is content that is visually hidden also hidden from AT, for example, using either HTML hidden or aria-hidden? Are show-hide toggles communicated to AT using aria-expanded?	1. Run Wave automated accessibility checker and inspect relevant results (tables, input fields, lists, etc.) 2. Right click on page elements and select 'inspect element". Inspect the markup to see whether or not it is correctly implemented 3. Inspect the heading structure using the HeadingsMap 4. Navigate through pages with the screen reader. Is the information on the page, such as form fields, tables, hidden content, show/hide toggles, etc. communicated accurately?	☐	☐	☐	☐
Comments:							
1.3.2: Meaningful Sequence	A	Does the programmatic order of content match the visual order?	Disable CSS styles (for example: Tools > Web Developer Extension > CSS > Disable Styles > Disable All Styles.) Does the order of the content still make sense?	☐	☐	☐	☐
Comments:							
1.3.3: Sensory Characteristics	A	Are there instructions that rely on sensory characteristics?	Read through instructions to see if any of them rely on sounds (e.g. the beep indicates), visual cues (e.g. fill out fields marked in red) or other	☐	☐	☐	☐

Success Criterion	Level	What to test for	Testing method	NA	PA	LA	FA
			sensory information				
Comments:							
1.4.1: Use of Colour	A	Is colour alone used to communicate information? Common examples include colour used to differentiate between body text and link text, and colour used to categorise content, such as correct or incorrect information	Look through the website to see if links and other information is communicated using only colour	☐	☐	☐	☐
Comments:							
1.4.2: Audio Control	A	Is there any audio on the MOOC that starts playing automatically and lasts more than 3 seconds? If yes, is it possible to stop the audio or adjust its volume without changing the system volume?	If the MOOC contains audio that plays automatically, check if there are controls that allow you to stop it or adjust its volume	☐	☐	☐	☐
Comments:							
1.4.3: Contrast (Minimum)	AA	Are there text/background colour combinations that have low contrast? The contrast requirement at Level AA is 4.5:1 for regular sized text and 3:1 for large text (18pt+) or bold text (14pt+)	Use the colour contrast analyser, checker or WAVE to check if different combinations of text and background colours throughout the MOOC meet criteria	☐	☐	☐	☐
Comments:							
1.4.4: Resize text	AA	Are there any display issues when resizing only the text on the page to 200%? Examples include overlapping, obscured or cut off content	Increase text size to 200% using the browser. Make sure that zooming in does not require horizontal scrolling, and that you are increasing the text size alone (e.g. in Firefox: View > Zoom > Zoom Text Only. In Chrome, Zoom Text Only extension)	☐	☐	☐	☐
Comments:							
1.4.5: Images of Text	AA	Are there any instances where the text is presented as an image? There is an exception to this criterion: • If a presentation is considered essential to the content (e.g. logos) • If the image of text is customizable by the learner	Select all content using “Ctrl+A” and check for text that is embedded in images. Alternatively, disable images using the browser settings or web developer tools	☐	☐	☐	☐
Comments:							
1.4.6: Contrast (Enhanced)	AAA	Are there text/background colour combinations that have low contrast? The contrast requirement at Level AAA is 4.5:1for large text (18pt+)	Use the colour contrast analyser, checker or WAVE to check if different combinations of text and background colours throughout the MOOC meet criteria	☐	☐	☐	☐
Comments:							

Success Criterion	Level	What to test for	Testing method	NA	PA	LA	FA
1.4.7: Low or No Background Audio	AAA	Are any non-speech sounds low enough that a learner can separate the speech from background sounds or other noise foreground speech content?	In case there exist Video or Podcast with background noise, the sound of the speech should be differentiated from any non-speech background, or: • The audio does not contain background sounds • The background sounds can be turned off	☐	☐	☐	☐
Comments:							
1.4.8: Visual Presentation	AAA	Is visually rendered text presented in such a manner that it can be perceived without its layout interfering with its readability?	Check that: 1. The learner can select foreground and background colours 2. Width is no more than 80 characters 3. The text is not justified (aligned to both the left and the right margins) 4. Line spacing (leading) is at least space-and-a-half within paragraphs, and paragraph spacing is at least 1.5 times larger than the line spacing 5. Text can be resized without assistive technology up to 200 per cent in a way that does not require the learner to scroll horizontally to read a line of text in a full-screen window	☐	☐	☐	☐
Comments:							
1.4.9: Images of Text (No Exception)	AAA	Is being implemented the text in a manner that allows its presentation to be changed or providing a mechanism by which learners can select an alternate presentation?	Check that images of text are only used for pure decoration. Or if a particular presentation of text is essential to the information being conveyed (quotes, letters, symbolic texts)	☐	☐	☐	☐
Comments:							

Principle 2: Operable

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add “Not Applicable” in the comments

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
2.1.1: Keyboard	A	Are all controls operable with a keyboard?	Navigate to the entire page using only “TAB” and “Shift+TAB” keys to check that all interactive elements receive focus and can be operated with a keyboard	☐	☐	☐	☐
Comments:							

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
2.1.2: No Keyboard Trap	A	Are there any sections on the page that trap keyboard focus?	Navigate through the entire page with a keyboard to make sure focus does not become trapped anywhere on the page	☐	☐	☐	☐
Comments:							
2.1.3 Keyboard (No Exception)	AAA	Are all the contents of the page operable from the keyboard?	Navigate to the entire page using only TAB and Shift+TAB keys to check that all interactive elements receive focus and can be operated with a keyboard with NO exception	☐	☐	☐	☐
Comments:							
2.2.1: Timing Adjustable	A	Does the MOOC contain any time limits that are shorter than 20 hours (such as getting logged out after a certain period)? If yes, is it possible to extend, adjust or turn off the time limit? The most common example of meeting this success criterion is an "Are you still there?" message that allows learners to indicate that they are still using the MOOC Time limits that are essential are exceptions to this criterion	Check for any time limits on the MOOC	☐	☐	☐	☐
Comments:							
2.2.2: Pause, Stop, Hide	A	Is there moving content on the page, such as carousels, sliders, or animations? If yes, is it possible to stop or hide the content?	For all moving content on the page, check that a mechanism exists that allows the learner to either stop or hide it	☐	☐	☐	☐
Comments:							
2.2.3: No Timing	AAA	Is timing an essential part of the event or activity presented by the content, except for videos or podcasts?	Check if there is any content that requires timed interaction for example in the tests or quizzes and in case there is it could be switched off	☐	☐	☐	☐
Comments:							
2.2.4: Interruptions	AAA	Can interruptions be postponed or suppressed by the learner?	Check if the MOOC has an automatic update that could distract the learner? Can that update be switched off?	☐	☐	☐	☐
Comments:							
2.2.5: Re-authenticating	AAA	Do learners complete authenticated transactions that have inactivity time limits or other circumstances that would cause a learner to be logged out while in the midst of completing the transaction?	Check if when an authenticated session expires (logging off manually), the learner can continue the activity without loss of data after re-authenticating	☐	☐	☐	☐
Comments:							

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
2.3.1: Three Flashes or Below Threshold	A	Is there any content that flashes more than three times per second?	Check whether the MOOC contains flashing content	☐	☐	☐	☐
Comments:							
2.3.2: Three Flashes	AAA	Is there any content that flashes more than three times per second?	Check whether the MOOC contains flashing content. No exception	☐	☐	☐	☐
Comments:							
2.4.1: Bypass Blocks	A	Is there a skip-to-content link at the top of each page that allows learners to bypass the navigation and move focus to the main content?	Navigate pages with a screen reader. Is a "skip to main content" link announced at the top of each page? Navigate the page with a keyboard. Is there a skip to content link at the top of the page that is either always visible or becomes visible when a learner tabs through the MOOC?	☐	☐	☐	☐
Comments:							
2.4.2: Page Titled	A	Do pages have unique and descriptive titles?	Check the text that appears at the top of the page tab in the browser or the <title> tag within the <head> of the HTML code. Is it unique and descriptive?	☐	☐	☐	☐
Comments:							
2.4.3: Focus Order	A	Does the order of focusable items follow a logical sequence?	Navigate through the focusable items on the page using the keyboard to check that the sequence is logical	☐	☐	☐	☐
Comments:							
2.4.4: Link Purpose (In Context)	A	Is the purpose of links clear?	Go through the links on the page (for example by tabbing through the page). Is the purpose of the links clear from the link text or the surrounding text (e.g. from the surrounding paragraph in the case of link text such as "Read more"), or through an aria-label or aria-labelledby attribute?	☐	☐	☐	☐
Comments:							
2.4.5: Multiple Ways	AA	Can the content of the MOOC be located in more than one way?	In addition to navigation, which is usually the primary way of locating content, can content be found via either a search function or a sitemap?	☐	☐	☐	☐

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
Comments:							
2.4.6: Headings and Labels	AA	Are the headings and labels on the MOOC clear and descriptive?	Look through the headings and labels on the MOOC to check if they are clear and descriptive	☐	☐	☐	☐
Comments:							
2.4.7: Focus Visible	AA	Is keyboard focus visible?	Navigate to the MOOC using a keyboard to check that focus is visible and easy to follow	☐	☐	☐	☐
Comments:							
2.4.8: Location	AAA	Is Information about the learner's location within the MOOC available?	Check if there is a sitemap, breadcrumb trail or navigation bars that indicate the location	☐	☐	☐	☐
Comments:							
2.4.9: Link Purpose (Link Only)	AAA	Can links be identified from link text alone?	Check if links to the same destination would have the same descriptions, but links with different purposes and destinations would have different descriptions	☐	☐	☐	☐
Comments:							
2.4.10: Section Headings	AAA	Are section headings used to organize the content?	Check if the structure of the document follows a correct structure with HTML (<h1>, <h2>, and so on)	☐	☐	☐	☐
Comments:							

Principle 3: Understandable

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add “Not Applicable” in the comments

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
3.1.1: Language Page	A	Is page language defined programmatically?	Inspect the HTML source code to see if the language is defined programmatically at the very top of the page at the beginning HTML tag (e.g. <html lang=”en”>)	☐	☐	☐	☐
Comments:							
3.1.2: Language of Parts	AA	Are the sections of text that are in a language that is different from the main document language? If yes, is the language defined for these sections of text?	Inspect the source code of the text section to see if the language is defined programmatically	☐	☐	☐	☐

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
Comments:							
3.1.3: Unusual Words	AAA	Is there a mechanism available for identifying specific definitions of words or phrases used in an unusual or restricted way, including idioms and jargon?	Check if there is a glossary with common terms or a dictionary or the specific definition of a word is provided at the bottom of the page	☐	☐	☐	☐
Comments:							
3.1.4: Abbreviations	AAA	Is there a mechanism for identifying the expanded form or meaning of abbreviations?	Check if there are Expanded forms of Abbreviations or an on-line acronym service	☐	☐	☐	☐
Comments:							
3.1.5: Reading Level	AAA	Is there text that requires advanced reading ability? Is there available a version that does not require reading ability advanced?	Check that content should be written as clearly and simply as possible, if there is complex test check that to ensure that, additional content is available to aid the understanding of the difficult or complex text	☐	☐	☐	☐
Comments:							
3.1.6: Pronunciation	AAA	Are there situations where the meaning of the words, in context, is ambiguous without knowing the pronunciation?	Check if there is a glossary to help with the pronunciation of difficult words, a sound file providing pronunciations or there is a dictionary or link for finding pronunciations for all foreign words in text content	☐	☐	☐	☐
Comments:							
3.2.1: On Focus	A	Are there any changes in context, such as a new window opening, focus shifting to a different element, or a new page loading, what happens when an element receives focus?	Tab through the page to ensure that no changes in context happen in focus	☐	☐	☐	☐
Comments:							
3.2.2: On Input	A	Are there inputs, such as radio buttons, select menus, text fields, etc., that initiate a change of context? For example, a form that gets submitted when the last input is filled out rather than providing a “submit” button	Fill out inputs on the MOOC to check if any changes in contexts happen without being initiated by the learner	☐	☐	☐	☐
Comments:							
3.2.3: Consistent Navigation	AA	Do navigation items, such as menu links, appear in the same order on the different page?	Check that navigation is consistent across pages	☐	☐	☐	☐

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
Comments:							
3.2.4: Consistent Identification	AA	Are components identified inconsistently throughout the MOOC? For example, a button says 'search' on one page and 'find' on another when the two perform the same function	Check that components, such as buttons and icons, are identified consistently across pages Check that component are labelled consistently across pages	☐	☐	☐	☐
Comments:							
3.2.5: Change in Request	AAA	Are the components that have the same functionality within the sample identified consistently?	Check if there is consistent labelling, this consistency extends to the text alternatives. If icons or other non-text items have the same functionality, then their text alternatives should be consistent as well	☐	☐	☐	☐
Comments:							
3.3.1: Error Identification	A	If errors are detected automatically (i.e. the form fails to submit and is returned to the learner), are they identified and described to the learner? For example, if the form is returned, fields that are filled out incorrectly are marked, and the error is described, for example, "First name is required"	Attempt to submit an empty form. If the form is returned with errors, check that incorrectly filled fields are identified, and error descriptions are given	☐	☐	☐	☐
Comments:							
3.3.2: Labels or Instructions	A	In interactive forms, are labels and descriptive, identify controls and provide instructions where necessary?	Go through any forms in the MOOC (contact, subscribe, etc.) and check the headings and labels on the page make the form and its components clear	☐	☐	☐	☐
Comments:							
3.3.3: Error Suggestion	AA	If errors are detected automatically, are suggestions given for fixing these errors? For example, if a field requires a specific format such as DD MM YY, is the learner notified when a wrong format is submitted?	Leave required fields blank and try to fill out fields that typically require a specific format, such as email and date fields, incorrectly. Are suggestions given when the form is returned with errors?	☐	☐	☐	☐
Comments:							
3.3.4: Error Prevention (Legal, Financial, Data)	AA	If a form requires the learner to submit financial or legal information, does it allow the learner to either reverse, review or confirm the submission?	This criterion can be difficult to test without attempting to submit financial or legal information	☐	☐	☐	☐
Comments:							

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
3.3.5: Help	AAA	Is there help text that provides information related to the function currently being performed?	Check if there is the context-sensitive help that only needs to be provided when the label is not sufficient to describe all functionality. The existence of context-sensitive help should be obvious to the learner, and they should be able to obtain it whenever they require it	☐	☐	☐	☐
Comments:							
3.3.6: Error Prevention (All)	AAA	Are there consequences that may result from making a mistake when submitting form data?	Check if when submitting an assignment or a quiz there are the following options available: • Reversible: Submissions are reversible • Checked: Data entered by the learner is checked for input errors, and the learner is provided with an opportunity to correct them • Confirmed: A mechanism is available for reviewing, confirming, and correcting information before finalising the submission	☐	☐	☐	☐
Comments:							

Principle 4: Robust

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add “Not Applicable” in the comments

Success Criterion	Level	What to test for	Testing Method	NA	PA	LA	FA
4.1.1: Parsing	A	Is markup language used to its specifications?	Run a few sample pages through the HTML validator	☐	☐	☐	☐
Comments:							
4.1.2: Name, Role, Value	A	When user interface components are custom, is the function (e.g. button) and state (e.g. selected) specified programmatically in a way that is accurately communicated to AT? Examples of custom controls include show/hide toggles, and inputs such as buttons and select menus that are created using divs and spans instead of standard HTML elements	Use a screen reader to navigate through the MOOC and pay attention to how custom controls are communicated Note: Many of the issues will be identified when testing Information and Relationships 1.3.1 criterion	☐	☐	☐	☐
Comments:							

Accessible PDF

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add “Not Applicable” in the comments

Success Criterion	**Testing Method**	**NA**	**PA**	**LA**	**FA**
5.1. Basic Requirements	• Run PAC3 on the PDF files available in the MOOC sample and that are part of the material produced by the MOOC (e.g. not external produced files) • Check that the evaluation does not include issues that would not allow the learner to use the file (Results in Detail – Basic Requirements)	☐	☐	☐	☐
The self-produced document: *Platform document:*					
5.2. Logical Structure	Check that the evaluation does not include issues that would not allow the learner to use the file (Results in Detail – Logical Structure)	☐	☐	☐	☐
The self-produced document: *Platform document:*					
5.3 Metadata and Settings	Check that the evaluation does not include issues that would not allow the learner to use the file (Results in Detail – metadata and settings)	☐	☐	☐	☐
The self-produced document: *Platform document:*					

Appendix 13: Study C. User Experience evaluation

The methodology to be used will be cognitive and UX walkthroughs, to identify usability and accessibility issues in a website or application.

The following criteria are part of the audit for MOOCs: 9 cognitive walkthroughs (platform design and access (6), educational resources (4), discussion, assignments, tests and quizzes (7), help: Report and feedback (2)) and 2 UX walkthroughs (MOOC design (4)) = 23

Sample

For this evaluation, the first two weeks of the MOOC are taken into consideration.

Tools used for auditing

- Chrome 63.0.3239.132
    - Web Developer Extension
- Firefox 57.0.3
    - Web Developer Extension
    - Custom Page Zoom
- Internet Explorer 11
- Screen reader: NVDA screen reader (Firefox)
- aDesigner
- Responsive Design Simulator

Cognitive walkthroughs

Narrative scenarios. 2 scenarios related to the platform, 3 to the educational resource and 4 to common tasks in MOOCs. Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add "Not Applicable" in the comments

Platform design and access

Name	**1 Registration and sign in**		**NA**	**PA**	**LA**	**FA**
What to test for	When taking part of a MOOC, you need to register once and sign in every time you want to access the MOOC					
Testing method	Enter the MOOC platform main page					
	1.1 MOOC platform registration	Register in the MOOC platform	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	1.2 MOOC platform sign in	Sign in into the MOOC platform using your credentials	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					

Name	**1 Registration and sign in**		**NA**	**PA**	**LA**	**FA**
	1.3 Password recovery	You cannot remember your password, try to retrieve it	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Name	**2 Search and navigation**		**NA**	**PA**	**LA**	**FA**
What to test for	You want to find a MOOC on a specific topic of your interest					
Testing method	Use the search engine page to look for a MOOC					
	2.1 MOOCs search	Try to find MOOCs that are going to start soon, on a topic you might be interested in, modifying the search settings	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	2.2 MOOC selection	Select one of the MOOCs and navigate around the description page	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	2.3 MOOC registration	Register for the chosen MOOC	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Educational resources

Name	**3 Educational Resource - Video**		**NA**	**PA**	**LA**	**FA**
What to test for	You are expected to work through educational bits on MOOCs (read articles and watch videos)					
Testing method	Go to an educational resource with a video					
	3.1 Video interaction	Watch the video, pause it, switch on the subtitles, and have a look into the transcriptions	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Name	**4 Educational Resource - Article**		**NA**	**PA**	**LA**	**FA**
What to test for	You are expected to work through educational bits on MOOCs (read articles and watch videos)					
Settings	Go to an educational resource with only text					
Comments:						
Testing method	4.1 Article interaction	Read the information available at your own pace	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					

Name	**5 Educational Resource – Electronic file**		**NA**	**PA**	**LA**	**FA**
What to test for	You are expected to work through educational bits on MOOCs (read articles and watch videos)					
Testing method	Go to an educational resource with a PDF file					
	5.1 File download	Download the file and open it	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	5.2 File interaction	Navigate around the document	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Discussion, assignments, tests and quizzes

Name	**6 Assignment**		**NA**	**PA**	**LA**	**FA**
What to test for	You have to do peer to peer activities in some MOOCs or another kind of assignments that require interaction between peers					
Testing method	Go to an assignment in the MOOC, if there are p2p one of them otherwise another type of assignment					
	6.1 Assignment instructions	Try to read the information related to the assignment, and the instructions on how to evaluate another learners work	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	6.2 Assignment achievement	Try to work through the assignment, try to fill in the information or upload a document	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	6.3 Assignment evaluation	Try to review or evaluate others work	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Name	**7 Discussion**		**NA**	**PA**	**LA**	**FA**
What to test for	In MOOCs, you find spaces to allow discussion among peers					
Testing method	Go to the forum or any other place available to allow discussion between learners					
	7.1 Discussion interaction	Read other learners post and comments and navigate through them	☐	☐	☐	☐
	Matthew: *Martha* *Deborah:* *Rebecca:*					
	7.2 Discussion adding comments	Add a comment and interact with other learners	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					

Name	**7 Discussion**	**NA**	**PA**	**LA**	**FA**
Comments:					

Name	**8 Quiz-Test**		**NA**	**PA**	**LA**	**FA**
What to test for	Quiz and tests are part of MOOCs, they are oriented to get feedback on your learning process and to get a certification					
Testing method	You go to one of the quizzes available in the MOOC					
	8.1 Quiz interaction	You can move around the quiz as you wish, answering questions with no specific order	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	8.2 Quiz feedback	Check if you have any feedback while replying to your questions, or when you have finished it to help you to reinforce your learning	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Help: Report and feedback

Name	**9 Help**		**NA**	**PA**	**LA**	**FA**
What to test for	There are moments you need to contact someone for help					
Testing method	Find a place where you think you could need help from a MOOC facilitator, either an assignment or a quiz can require help					
	9.1 Help interaction	Try to find information around to contact for help	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	9.2 Help contact	Contact a facilitator to ask for help	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

UX walkthroughs

Narrative scenarios. 2 scenarios related to the user experience in learning design

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add “Not Applicable” in the comments

MOOC design

Name	**10 MOOC experience**	**NA**	**PA**	**LA**	**FA**
What to test for	Learners face situations related to their personal life and disability that can affect their learning on for the whole MOOC				
Testing method	Go to the description page where all the information related to the work that has to be done for the whole MOOC is detailed				

Name	**10 MOOC experience**		**NA**	**PA**	**LA**	**FA**
	10.1 MOOC workload	Consider if the work that has to be achieved is consistent with the number of hours dedicated to the MOOC	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	10.2 MOOC syllabus	Consider if there are enough resources and feedback provided considering the persona to work around the whole MOOC	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Name	**11 Week experience**		**NA**	**PA**	**LA**	**FA**
What to test for	Learners face situations related to their personal life and disability that can affect their learning week by week					
Testing method	Go to the description page where all the information related to the work that has to be done that week is detailed					
	11.1 Week workload	Consider if the information provided at the beginning of the week is enough to organise the persona's work for that week	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
	11.2 Week syllabus	Consider if there are enough resources and feedback provided considering the persona to work on that week	☐	☐	☐	☐
	Matthew: *Martha:* *Deborah:* *Rebecca:*					
Comments:						

Appendix 14: Study C. Personas

Matthew

Middle age learner, UK
School-leaving qualification
Unwaged and seeking employment
Mental health difficulties

Experience with MOOCs

33 completed MOOCs in FutureLearn, Coursera, Open2Study and edX

Interest in MOOCs

"MOOCs are a good way to find out which subjects are worth pursuing as well as broadening my range of knowledge and MOOCs also help me cope with my conditions by occupying my mind and providing the 'little victories' I need each day"

Barriers to Learning

"My mental health conditions make it hard to participate sometimes. Occasionally it can be the time-limited nature of the MOOC that causes a problem. Occasionally a MOOC won't engage me enough to want to finish"

Habits while accessing to MOOCs

Mathew enjoys following MOOCs in his Laptop at home when he is in a good mood and can concentrate on the tasks

Setting up the scenario

Matthew uses a laptop with Mozilla Firefox on a Windows 7, he uses the laptop mouse pad

Martha

Middle age learner, USA
Undergraduate / Bachelors university degree
Disabled and not able to work
Partially sighted, restricted mobility, restricted manual skills, fatigue or pain, Chronic pain

Experience with MOOCs

Over a hundred FutureLearn courses

Interest in MOOCs

"I need to keep my mind sharp since I am disabled. MOOCs are the perfect vehicle for that""

Barriers to Learning

"I hate doing any peer review exercises and prefer to skip them or abandon the course when I get to them. Sometimes they are necessary as in writing courses, or other creative courses, but nowhere else!"

Habits while accessing to MOOCs

Martha enjoys taking up MOOCs on the afternoon when she does not have to take care of family issues; she uses the desktop computer available at home and adapted to her needs

Setting up the scenario

Martha is partially sighted, she generally uses the Windows magnifier, but sometimes she uses a screen reader on google chrome, depending on how she feels and how much she wants to use her hands or relax her efforts reading the screen. She uses a desktop computer configuration. To simulate that test can be done with NVDA screen reader, windows magnifier and aDesigner simulator for low vision. It is important to check that the use of mouse and keyboard fits with restricted mobility

Deborah

Mature learner, UK
School-leaving qualification
Full time carer for severely disabled familiar
Hard of hearing

Experience with MOOCs

About 40 Future Learn courses

Interest in MOOCs

"I needed a mental outlet and something I could do at home. MOOCs was just what I needed, short, challenging, huge variety of courses the chance to choose topics I wouldn't have been able to do in school and free which was a big factor"

Barriers to Learning

"Sometimes the subtitles were not available or transcriptions to related videos. Some of the PDF documents needed a subscription, which was not possible. I am in my 60's so to compare my computer skills to younger people whose computer skills are part of their lives and upbringing made me feel out of my depth sometimes"

Habits while accessing to MOOCs

Deborah is busy taking care of a familiar; she likes to spend free time on her desktop with MOOCs

Setting up the scenario

Deborah has a hard hearing; she uses internet explorer on a desktop computer with windows. She needs to read the subtitles or read the transcripts, in case she could open them in a PDF file to read them. She enjoys using the computer, but she has not a long experience using it

Rebecca

Young Learner, France
Postgraduate / Graduate school university degree
Full-time employed / self-employed
Dyslexia or other specific learning difficulties

Experience with MOOCs

FutureLearn and Shaw academy

Interest in MOOCs

"I was interested, as my job at the time was very mundane and unchallenging. I felt I was missing out on learning about new and interesting topics. I felt unchallenged and wanted to challenge myself and use my brain more to better myself and absorb more knowledge"

Barriers to Learning

"A MOOC had a live webinar was every Tuesday evening. I would sometimes miss it due to work. I could still play catch up but was often worried I would get left behind. There have also been some other courses that I have taken that were not for me; they were not challenging enough"

Habits while accessing to MOOCs

Rebecca has not used MOOCs that much, but she enjoys them when she finds some time coming back home from work on her sofa. She is French; she feels more comfortable if subtitles and transcripts are available in that language

Setting up the scenario

Rebecca is dyslexic, she uses android with chrome, and for that reason, and the configuration can be used with the web developer tools for Chrome to simulate the use of it. Check the availability to personalise the learning to a non-English language

Appendix 15: Study C. Quality evaluation

These checklists are based on OpenUpEd, BizMOOC and Score 2020 projects where the European Association of Distance Teaching Universities (EADTU) has participated.

The following criteria are part of the audit for MOOCs: 13 related to MOOC criteria, 30 to the quality of the design of MOOC and 9 for the technical platform and support for learners = 52.

Sample

For this evaluation, all the MOOC is considered as a whole but for specific tasks, the first two weeks of the MOOC are taken into consideration

The MOOC criteria

Based on the MOOC definition "An online course designed for large numbers of learners that can be accessed by anyone anywhere as long as they have an Internet connection, are open to everyone without entry qualifications and offer a full/complete course experience online, for free. Check if the online course meets the MOOC criteria

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add "Not Applicable" in the comments

Criteria	What to test for	Testing method	NA	PA	LA	FA
1.1.1 Massive	The (pedagogical model of the) course is such that the efforts of all services (including of academic staff on tutoring, tests, etc.) do not increase significantly as the number of learners increases	A MOOC differs from other Open Online Courses by the number of learners. There is no precise number to define "massive", and it might even depend on characteristics like some people speaking the language of the MOOC offered. As such the number of learners is larger than can be taught in a 'normal' campus classroom/college situation (FA)	☐	☐	☐	☐
Comments:						
1.2.1 Open -enrolment	All learners can enrol without limitations	Some MOOC providers do put a limit on people who can access the course. For example by having an age limit of 16 or block learners from sanctioned countries (so not accessible by anyone anywhere). There is not a maximum number of learners admitted in the MOOC or any distinction to get access (e.g. age or previous courses taken) (FA)	☐	☐	☐	☐
Comments:						

Criteria	What to test for	Testing method	NA	PA	LA	FA
1.2.2 Open - access	At least the course content is always accessible once enrolled	Most MOOCs nowadays do not provide access all the time. However, they do provide access to the course during the limited time, mostly only between the start and end date of course. For some MOOC providers, the content of MOOCs is always accessible even if they have a fixed starting and ending date during which they guarantee the availability of course content on the platform. In other MOOCs, both the content and forum are always accessible. Also, very few MOOC providers offer courses that always provide access to the whole course by anyone anywhere. the educational resources, assignments, discussions and quizzes can be accessed anytime during the MOOC (all of them FA)	☐	☐	☐	☐
Comments:						
1.2.3 Open - location	The course can be accessed anywhere (location, browser, device, etc.) as long as they have an internet connection	MOOC can be accessed independently of the country where you are located. MOOC can be accessed using a desktop computer, a laptop or a mobile phone (platform offers a mobile app), it works using different browsers. Access is granted independently of the device or user agent used (FA)	☐	☐	☐	☐
Comments:						
1.2.4 Open - prior knowledge	No pre-requisites/diplomas needed to participate in the online course	That doesn't imply that MOOCs are only offered at the novice level. All MOOCs require some basic skills of Information and communication technology (ICT) and language skills by definition. And some courses require extensive prior knowledge and skills. But these knowledge and skills are not tested beforehand, nor are any formal qualification needed to enter the course. There are no qualifications from the MOOC platform or any other HE institution to access the MOOC (FA)	☐	☐	☐	☐
Comments:						
1.2.5 Open - free	Full course experience without any costs for learners	MOOC learners should be offered a complete course experience without any costs (for free), including assignments, quizzes and tests. However, additional services may be offered as part of the business model. Such services may include remedial courses, additional tutoring by academic staff and additional certification options. Regarding the latter, learners should always have the opportunity to get a badge or a certificate of completion for free (that's an important difference between open courseware and MOOCs). The course can be accessed without any cost, for free and get a basic certificate (FA)	☐	☐	☐	☐
Comments:						

Criteria	What to test for	Testing method	NA	PA	LA	FA
1.3.1 Online	All aspects of the course are delivered online	The learner of a MOOC can choose to have some offline activities (the criteria uses "delivered online") or that additional services require face-to-face (f2f) meeting or even the presence at an exam/test centre for an additional certificate. But such off-line / f2f activities are not part of MOOCs, i.e. are only optional. Learners cannot be asked to attend a meeting at a certain place as obligatory (FA)	☐	☐	☐	☐
Comments:						
1.4.1 Course - study unit	The total study time of a MOOC is minimal 1 ECTS (typically between 1 and 4 ECTS)	To secure that a MOOC is a unit of study, we defined that the total work/study load for a learner should be at least 1 European Credit Transfer and Accumulation System (ECTS). In a European context, we measure the amount of study time in units of ECTS (about 25-30 study hours). As such one criterion for a course to be called a MOOC is that total study time of a MOOC should be at least 1 ECTS (FA)	☐	☐	☐	☐
Comments:						
1.5.1 Full course - educational resource	Educational resource should include Video – Audio - Text – Games (incl. simulation) – Social Media – Animation	There is variability of educational resource types, being Video predominant in MOOCs (FA)	☐	☐	☐	☐
Comments:						
1.5.2 Full course - interactivity	Offers possibilities for interaction, such as social media channels, forums, blogs or RSS readers	The MOOC includes areas of discussion such as forums and allows the participation and interaction of learners (FA)	☐	☐	☐	☐
Comments:						
1.5.3 Full course- feedback	Learners are provided with some feedback mechanism. Can be automatically generated (e.g., quizzes), only by peers (peer feedback) and general feedback from academic staff, etc.	There is peer to peer assignments that allow reviewing and get feedback from other peers; quizzes generate automatic feedback to help the learner (FA)	☐	☐	☐	☐
Comments:						
1.5.4 Full course - certification	Always includes some recognition like badges or a certificate of completion. A formal certificate is optional and most likely has to be paid for	There is a free recognition when finishing the MOOC that can be a badge or an informal certificate. A paid certificate is always optional (FA)	☐	☐	☐	☐
Comments:						
1.5.5 Full course - syllabus	Study guide/syllabus includes instructions as to how you may learn from the presented materials and interactions	The MOOC includes a guide where all the instructions on how to use the different resources in the MOOC are explained (FA)	☐	☐	☐	☐

Criteria	What to test for	Testing method	NA	PA	LA	FA
Comments:						

Quality of the design

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add “Not Applicable” in the comments

Criteria	What to test for	Testing method	NA	PA	LA	FA
2.1.1 Target group - various groups	MOOCs are accessible to all learners and as such various target groups are identified	MOOC is available for everyone, and different target learners have been identified (“who should take this course”), that can be seen in the way the educational resources have been designed and in the way the learning goals of the course are presented, allowing different group to participates to choose different learning goals (FA)	☐	☐	☐	☐
Comments:						
2.1.2 Target group - prior knowledge	For each target group, the needs, challenges, prerequisites and prior knowledge are described	At the beginning of the MOOC, the identification of prerequisites and prior knowledge for each group is described. There are several options that can be chosen by each group, allowing them to decide their learning goals (FA)	☐	☐	☐	☐
Comments:						
2.2.1 Workload - schedule	The schedule of the course is such that the workload per week is feasible for learners from the target group (typical 6-8 hours for those with full-time jobs)	The workload of the MOOC is around 6-8 hours a week maximum, and it is indicated that way (FA)	☐	☐	☐	☐
Comments:						
2.2.2 Workload - pace	The MOOC is realistic in its pacing for the learner, accommodating to the individual's rhythm	There is flexibility for the learn to take part in the assignments or quizzes, dedicate time in all the educational resources, and to be able to discuss with other learners in all the weekly expected workload (FA)	☐	☐	☐	☐
Comments:						
2.3.1 Overall goal	The overall goal of the course is described in a few sentences	The objective of the course is described at the very beginning of the MOOC (before enrolment) simply and shortly but clear (FA)	☐	☐	☐	☐
Comments:						

Criteria	What to test for	Testing method	NA	PA	LA	FA
2.4.1 Learning goals - limited	The course presents a limited number of learning goals	The learning goals are clear from the beginning of the MOOC and can be identified (FA)	☐	☐	☐	☐
Comments:						
2.4.2 Learning goals - statement	A clear statement of learning goals for both knowledge and skills is provided	The learning goals are clearly from the beginning of the MOOC and can be identified (FA)	☐	☐	☐	☐
Comments:						
2.4.3 Learning goals - lifelong learning	Learning goals align with Lifelong Learning	Learning goals are valid for any learner considering Lifelong Learning (LLL), therefore supports learning at all ages an academic background (FA)	☐	☐	☐	☐
Comments:						
2.4.4 Learning goals - coherence	There is reasoned coherence between learning goals, course content, teaching and learning strategy (including the use of media), and assessment methods	At the beginning of the MOOC a clear relation between the four is outlined (FA)	☐	☐	☐	☐
Comments:						
2.4.5 Learning goals - prior knowledge	The prior knowledge of each learning goal is described and related to characteristics of target groups	At the beginning of the MOOC, it is clear that there is a need for prior knowledge before starting the course or no prior knowledge is required; target groups are considered (FA)	☐	☐	☐	☐
Comments:						
2.5.6 Learning activities - assignments	Assignments aid learners to construct their learning and to communicate it to others	The assignments allow space for a constructive discussion between learners (FA)	☐	☐	☐	☐
Comments:						
2.5.7 Learning activities - levels of difficulty	The activities are designed in such a way that they can be performed at different levels of difficulty or complexity, to account for the broad spectrum of learners' knowledge and skills that is expected	Different activities such as assignments, discussions, and quizzed allow different target learners to participate in their learning goals (FA)	☐	☐	☐	☐
Comments:						
2.5.8 Learning activities - participation	Various activities are proposed with different formats. For example, quizzes, peer-to-peer assignments, video conferences (Hangouts), participation in the forums and platform social networks or external social networks (Facebook, Twitter)	MOOC allows participation through different activities such as educational resources, assignments, quizzes and considers external tools such as social networks (FA)	☐	☐	☐	☐

Criteria	What to test for	Testing method	NA	PA	LA	FA
Comments:						
2.5.9 Learning activities - learning pathways	The MOOC contains differing levels of difficulty, with different learning pathways	The target groups can follow different pathways in the MOOC. The learners can decide if they want to participate in the assignments, quizzes or discussions and still can reach their learning goals (FA)	☐	☐	☐	☐
Comments:						
2.5.10 Learning activities - engagement	The MOOC contains enough interactivity (learner-to-content, learner-to-learner or learner-to-teacher) to encourage active engagement	There are options to engage with the educational resources, other learners, academics and facilitators in the MOOC (FA)	☐	☐	☐	☐
Comments:						
2.6.1 Resources - range	A range of resources are used	The MOOC offers learning experience using videos, text, links, podcasts, documents etc. different ways to engage with the learning experience (FA)	☐	☐	☐	☐
Comments:						
2.6.2 Resources - license policy	Clear references to any re-used and open licenced resources	Following the MOOC definition, there is a guideline and policy about licenses for the resources included in the MOOC (FA)	☐	☐	☐	☐
Comments:						
2.6.3 Resources - license information	Open license information for MOOC and each MOOC resource is provided	Following the MOOC definition, resources have clear licensed description (FA)	☐	☐	☐	☐
Comments:						
2.6.4 Resources - consistency	Each section is of a similar length, and resources are consistent in presentation	Each part of the MOOC takes a similar time to be completed and remain a similar presentation of the content. The content available each week remains consistent (FA)	☐	☐	☐	☐
Comments:						
2.6.5 Resources - examples	A range of examples is used in the resources (e.g. videos). These should be diverse and not reinforce stereotypes	Every educational resource should have several examples and explanations to allow comprehension considering social and cultural diversity (FA)	☐	☐	☐	☐
Comments:						
2.7.1 Feedback mechanism - scalability	Feedback by an academic tutor is limited but scalable (characteristic of MOOC)	Facilitators can offer general help and have spaces to allow to use their limited time to help the maximum number of learners (FA)	☐	☐	☐	☐

Criteria	What to test for	Testing method	NA	PA	LA	FA
Comments:						
2.7.2 Feedback mechanism - regularity	The MOOC provides learners with regular feedback through self-assessment, quizzes, tests or peer reviews	There are regular activities around the weekly bases that allow the learner to get feedback for her learning process (FA)	☐	☐	☐	☐
Comments:						
2.7.3 Feedback mechanism - frequency	The frequency of monitoring has been planned	Facilitators help conversations in the forums, adding information and updating the learners (FA)	☐	☐	☐	☐
Comments:						
2.7.4 Feedback mechanism - announcement	A weekly announcement or massive mailing with orientations for the following week is planned	There is an advanced email giving orientation about the content for the next week (FA)	☐	☐	☐	☐
Comments:						
2.7.5 Feedback mechanism - synthesis	In each weekly session, the pedagogical team makes a synthesis of artefacts from the previous week's session	There is a summary of the concepts learnt during the previous week (FA)	☐	☐	☐	☐
Comments:						
2.7.6 Feedback mechanism- live-events	Some live-events (Hangout, Tweetchat) are scheduled	Some events allow interaction outside the platform, as they allow more options for feedback and interaction (these events are never compulsory) (FA)	☐	☐	☐	☐
Comments:						
2.8.1 Assessment - learning goals	Learning goals are assessed using a balance of formative and summative assessment appropriate to the level of certification	The tests address the learning goals being coherent with the level of certification (FA)	☐	☐	☐	☐
Comments:						
2.8.2 Assessment - plagiarism	Assessment is explicit, fair, valid and reliable. Measures appropriate to the level of certification are in place to counter impersonation and plagiarism	The certification is coherent with the content of the MOOC and takes into account impersonation and plagiarism (FA)	☐	☐	☐	☐
Comments:						
2.8.3 Assessment - badge	Learners can earn a badge for completion of learning activities	There are badges available in MOOCs that can be used to show their completion (FA)	☐	☐	☐	☐

Criteria	What to test for	Testing method	NA	PA	LA	FA
Comments:						
2.8.4 Assessment - progress	The MOOC has possibilities to follow the score and progression	The MOOCs allows the learner to track their progress in the MOOC and score during the different parts that had a test (FA)	☐	☐	☐	☐
Comments:						

Technical platform and support for learners

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add "Not Applicable" in the comments

Criteria	What to test for	Testing method	NA	PA	LA	FA
3.1.1 Platform - reliability	The MOOC platform is reliable, secure and assures appropriate levels of privacy. Provision is made for system maintenance, monitoring and review of performance	MOOC is secure, has password control, and the possibility to update the password, or help in case it has been forgotten, the learner has its profile area where she can update the preferences and security, removing personal data. The platform is reliable and usually works (FA)	☐	☐	☐	☐
Comments:						
3.1.2 Platform - online tools	The MOOC platform provides a range of online tools which are appropriate for the educational models adopted	The MOOC allows using different devices (e.g. forum, chat, email, able to upload or share documents, note taking etc.) depending on the pedagogical approach followed by the MOOC (FA)	☐	☐	☐	☐
Comments:						
3.2.1 Support for MOOC learners - profile	Learners have access to their learning environment, follow progression, tasks, completion, badges, and publications	Learners have in their profile non-public information that allows them to track their learning path in the MOOC (FA)	☐	☐	☐	☐
Comments:						
3.2.2 Support for MOOC learners - social networks	The institution uses social networking media to foster academic communities among MOOC learners	In the MOOC social networks are used to foster academic communities and learning, as a tool to improve the learning experience (FA)	☐	☐	☐	☐
Comments:						
3.2.3 Support for MOOC learners - help	MOOC learners have clear routes to academic, technical and administrative support	Learners can know easily how to ask for help and who to ask depending on the type of help (technical or academic) (FA)	☐	☐	☐	☐

Criteria	What to test for	Testing method	NA	PA	LA	FA
Comments:						
3.2.4 Support for MOOC learners - technical guideline	A technical guideline for good navigation assists the learner	The learner has access to a guideline to help her to navigate around the MOOC (FA)	☐	☐	☐	☐
Comments:						
3.2.5 Support for MOOC learners - FAQ	Also, an FAQ is in place to support learners navigation	There is access to an FAQ with general information about the platform	☐	☐	☐	☐
Comments:						
3.2.6 Support for MOOC learners - Pedagogical guideline	Pedagogical guidelines for good learning assist the learner	Guidelines are independent of the technology to help the learner to achieve their learning goals (FA)	☐	☐	☐	☐
Comments:						
3.2.7 Support for MOOC learners - feedback instructions	A list of criteria for the learning activities, specifically for feedback, is available	In the assignments, there are clear instructions on how to provide profitable and beneficial feedback to peers (FA)	☐	☐	☐	☐
Comments:						

Appendix 16: Study C. Learning design evaluation

These checklists are based on Universal Design for Learning (UDL) Guidelines: Version 2.1. CAST (2014). *Universal Design for Learning Guidelines version 2.0.* Wakefield, MA).

The following criteria are part of the audit for MOOCs: 10 Engagement, 12 Representation and 9 Action and Expression = 31

Sample

For this evaluation, the first two weeks of the MOOC are taken into consideration

Levels

1. Not achieved = The feature to test is missing
2. Partially achieved =The feature to test is available but not integrated into learning design
3. Largely achieved = The feature to test is available and partially integrated to learning design
4. Fully achieved = The feature to test is available and fully integrated to learning design

Evaluations are MOOC oriented, even if a feature is available in the platform it should be used and implemented in the learning design of the MOOC.

Principle 3: Provide Multiple Means of Engagement

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add "Not Applicable" in the comments

Guideline and Checkpoint	**What to test for**	**Testing method**	**NA**	**PA**	**LA**	**FA**
7.1 Optimise individual choice and autonomy	Learners have autonomy to choose: the level of challenge, practising and assessing skills, tools used for information gathering or production in assignments, deciding the time for completion of tasks	Learners should be able to choose their challenges while participating in discussions and assignments in the MOOC, to choose the timing for completing the educational resources or assignments	☐	☐	☐	☐
Comments:						
7.2 Optimise relevance,	1. There exist different assignments and educational resources that could be: personalised and contextualised to learners' lives, culturally or socially	The assignments and the educational resources allow learners to introduce their cultural background and identify themselves, as well help to connect the	☐	☐	☐	☐

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
value, and authenticity	relevant and appropriate for different racial, cultural, ethnic, and gender groups 2. Assignments proposed to facilitate that Learning goals are authentic, communicate to real audiences, and reflect a purpose that is clear to the learners 3. The assignments allow for active participation, exploration and experimentation 4. There is scope for a personal response, evaluation and self-reflection to educational resources and assignments 5. Some assignments foster the use of imagination to solve novel and relevant problems or make sense of complex ideas in creative ways	learning goals and the context of the learner, the possibility to explore with them, reflect and allow to use their imagination and be creative				
Comments:						
7.3 Minimise threats and distractions	1. There exist schedules that can increase the predictability of assignments, some alerts and previews can help learners anticipate and prepare for changes in assignments 2. Learners can vary the presence of visual stimulation, number of features or items presented at a time, regulate his pace of work and timing or sequence of assignments 3. Learners can vary the social demands required for learning or performance by participating in forums, assignments or tests 4. All learners can be involved in whole MOOC discussions	Information about assignments is notified to learners, and there is access to a schedule with all the information, as well the learning environment can be personalised to hide or view elements, the assignments can be varied in order and pace. Learners can decide how much they want to participate in the different parts of the MOOC and access all the discussions openly. Learning design should provide options for discussion, check if several types of interaction with learners are provided.	☐	☐	☐	☐
Comments:						
8.1 Heighten salience of goals and objectives	1. Learners are required to formulate their goals explicitly 2. The goal is displayed in multiple ways 3. Learners are engaged in discussions of what constitutes examples that connect to their cultural background and interests	At the beginning of the MOOC, learners can formulate their goals; goals are displayed as well with examples of achievement and learners can discuss their interests in forums or assignments	☐	☐	☐	☐
Comments:						
8.2 Vary demands and resources to optimise challenge	The MOOC should differentiate the degree of difficulty or complexity within which core assignments can be completed	Based on the theory of the hierarchy of knowledge. Not all learners require the same difficulty and complexity, that should be contemplated	☐	☐	☐	☐
Comments:						

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
8.3Foster collaboration and community	1. Some prompt guide learners in when and how to ask peers and facilitators for help 2. The MOOC should help to create in the forums communities of learners engaged in common interests or assignments, creating expectations for group work	Information and help to foster collaboration are provided, there are forums with different topics to encourage learners to discuss and build community in the MOOC	☐	☐	☐	☐
Comments:						
8.4 Increase mastery-oriented feedback	The MOOC provides feedback that encourages perseverance, focuses on the development of efficacy and self-awareness. The input is frequent, timely, and specific, substantive and informative rather than comparative or competitive and models how to incorporate evaluation, including identifying patterns of errors and wrong answers, into positive strategies for future success	Based on Dweck, feedback has to be thought to help learner, be proactive in giving positive indications to reach the educational goals	☐	☐	☐	☐
Comments:						
9.1 Promote expectations and beliefs that optimise motivation	1. The MOOC provides guides that focus on self-regulatory goals in response to frustration, increasing the length of on-task orientation in the face of distractions and elevating the frequency of self-reflection and self-reinforcements 2. The MOOC provides examples that model the process of setting personally appropriate goals that take into account both strengths and weaknesses 3. The MOOC supports activities that encourage self-reflection and identification of personal goals	Test and quizzes provide automated feedback, as well, there are examples to show variable goals that can be achieved for learners with different strengths and weaknesses, learners can reflect in private space to take notes or discuss with another learner with privacy (one to one)	☐	☐	☐	☐
Comments:						
9.2 Facilitate personal coping skills and strategies	The MOOC provides differentiated feedback for: managing frustration, seeking external emotional support and developing internal controls and coping skills	There are in the discussions, originated from facilitators, ways to develop coping skills. In forums, learners can create discussions about coping skills	☐	☐	☐	☐
Comments:						
9.3 Develop self-assessment and reflection	The MOOC offers devices to assist individuals in learning to collect and display data from their behaviour for monitoring changes in those behaviours	There are ways to support learners in situations where they have missed part of the MOOC or are not being able to follow scheduled assignments	☐	☐	☐	☐
Comments:						

Principle 1: Provide Multiple Means of Representation

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add "Not Applicable" in the comments

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
1.1 Offer ways of customising the display of information	1. It is possible to vary the size of text and visual content, as well as the contrast between background and text. 2. The colour used for information or emphasis passes the blind colour test. 3. The volume and rate of speech or sound in the videos and podcasts can be varied	It is possible to change the size of text, disposition of elements, excellent quality of the images and graphs (built-in if possible), and volume and rate in videos can be varied with built-in tools. If needed you can use ColorOracle	☐	☐	☐	☐
Comments:						
1.2 Offer alternatives for auditory information	1. Subtitles for spoken language in the video are available 2. Transcripts for spoken language for video and podcasts are provided 3. Visual diagrams and charts for videos and podcasts are provided 4. Sign language for the spoken language in the video is available 5. Visual analogues to represent emphasis and prosody in the text are provided	Subtitles for spoken language in the video are available and can be switched on and off, transcripts for spoken language for video and podcasts are submitted and can be downloaded in a separate file, and sign language for spoken language in the video is available and can be switched on and off. There are diagrams and charts for videos and podcasts to complement the meaning, visual analogues to represent emphasis and prosody in the text.	☐	☐	☐	☐
Comments:						
1.3 Offer alternatives for visual information	1. All images and videos have a description and alternative description 2. There are auditory cues for key concepts and transitions in visual information 3. Text-to-speech works properly	Exist an explanation and an alternative description for images and videos; audio includes descriptive information of what it is happening in the videos, text-to-speech tools are built in the MOOC. If needed you can use NVDA	☐	☐	☐	☐
Comments:						
2.1 Clarify vocabulary and symbols	1. There is a glossary of terms to pre-teach vocabulary and symbols at the beginning of the MOOC, especially in ways that promote connection to the learners' experience and prior knowledge 2. Complicated terms, expressions, or equations are explained with simpler words or symbols	There is a glossary of terms that will be used during the MOOC, the use of language is simple and comprehensible, a dictionary is embedded in the MOOC in the same language than the MOOC is taught	☐	☐	☐	☐

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
	3. There is an embed dictionary for vocabulary, symbols and unfamiliar references within the text					
Comments:						
2.2 Clarify syntax and structure	1. The structural relations and relationships between the elements in the MOOC are explicit 2. There are connections to previously learned structures during the MOOC	The structure of the MOOC content is similar and keeps the same style and structure, keeping consistency with the terminology. The content delivered is consistent across the course modules (e.g. using the same syntax for concepts like multiplication across the module)	☐	☐	☐	☐
Comments:						
2.3 Support decoding of text, mathematical notation, and symbols	There is offered clarification of notation through lists of key terms for the mathematical expressions and symbols	Mathematical terms are clarified using an index or glossary; mathematical content should be accessible using a screen reader If needed you can use NVDA	☐	☐	☐	☐
Comments:						
2.4 Promote understanding across languages	1. All vital information in the dominant language is available in other languages 2. Key vocabulary words to definitions and pronunciations in both original and other languages are provided 3. Links to multilingual glossaries on the web are provided	Other languages are supported in the MOOC including subtitles and transcripts, the information related to keywords is available in other languages including the pronunciation, external links to other languages glossaries are available	☐	☐	☐	☐
Comments:						
2.5 Illustrate through multiple media	1. Key concepts are presented in one form of symbolic representation with an alternative form 2. There are explicit links between information provided in texts and any accompanying representation of that information in illustrations, equations, charts, or diagrams	Key concepts are available in several formats images, text, video or graphs and the relation between those is clear	☐	☐	☐	☐
Comments:						
3.1 Activate or supply background knowledge	1. Critical prerequisite concepts are explained at the beginning of the MOOC 2. Concepts are bridged with relevant analogies and metaphors 3. Explicit cross-curricular connections are made	Key concepts needed to study the MOOC are described at the beginning, with clear examples to bridge the concepts and considering different curricula between learners	☐	☐	☐	☐
Comments:						

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
3.2 Highlight patterns, critical features, big ideas, and relationships	1. Key elements in the text, graphics, diagrams, formulas are emphasised 2. There are multiple examples to emphasise and prompts to draw attention to critical features 3. Previously learned skills that can be used to solve unfamiliar problems are highlighted	Key elements in different formats are clear and distinguishable, various examples of essential features are provided, and places where having previous knowledge could help are pointed out	☐	☐	☐	☐
Comments:						
3.3 Guide information processing, visualisation, and manipulation	1. There are explicit prompts for each step in a sequential process 2. There are multiple entry points to educational resources, and optional pathways through content 3. Information is provided in small elements 4. Information is released progressively 5. There are not unnecessary distractions	The sequential process of the MOOC is transparent, as well, the educational resources can be accessed following different paths through the platform, and are small elements, not released all at once	☐	☐	☐	☐
Comments:						
3.4 Maximise transfer and generalisation	1. The MOOC platform provides organisers, notes, electronic reminders 2. The assignments and forums incorporate explicit opportunities for review and practice 3. There are templates, graphic organisers, and concept maps to support note-taking	There exist tools for the learners to personalise their work, as well they can review and practice with other learners and generalise the learning	☐	☐	☐	☐
Comments:						

Principle 2: Provide Multiple Means of Action and Expression

Levels: NA (Not achieved); PA (Partially achieved); LA (Largely achieved); FA (Fully achieved). If it is not relevant, add “Not Applicable” in the comments

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
4.1 Vary the methods for response and navigation	1. There are alternatives for rate, timing and speed required to interact with the educational resources and assignments 2. There are alternatives for indicating selections by mouse control and	There is no time limit to testing course materials or with other learners while doing an assignment	☐	☐	☐	☐

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
	interacting with materials by keyboard					
Comments:						
4.2 Optimise access to tools and assistive technologies	1. There are alternative keyboard commands for mouse action 2. The MOOC platform works seamlessly with keyboard alternatives and alt keys	There are combinations of keyboard commands to do the same than with the mouse; you can move around the MOOC using only the keyboard	☐	☐	☐	☐
Comments:						
5.1 Use multiple media for communication	1. There is the use of complementary external social media and interactive web tools 2. The MOOC has compositions in various media such as text, podcast, video, images, graphs, or PDF files	MOOC promotes the use of social media and other tools outside the MOOC, uses multiple media (e.g. not only video)	☐	☐	☐	☐
Comments:						
5.2 Use various tools for construction and composition	1. There are spellcheckers, grammar checkers, word prediction software built-in to help the learner 2. There are available external web applications to access for more information to help the learner	MOOC provides built-in software to help with the grammar and word prediction; there are external links to resources and tools to help the learner to find out more information	☐	☐	☐	☐
Comments:						
5.3 Build fluencies with graduated levels of support for practice and performance	1. Differentiated models to emulate that demonstrate the same outcomes but use differing approaches 2. Differentiated types of facilitators and academics with different roles are provided 3. Differentiated feedback is provided	Different ways to obtain the same Learning goals in the MOOC are provided, different feedbacks is provided by learners, academics and in an automatic way	☐	☐	☐	☐
Comments:						
6.1 Guide appropriate goal-setting	1. There are prompts to estimate effort, resources, and difficulty 2. There are examples, guides and checklists for scaffolding goal-setting	Some prompts help the learner to keep stimulated, standards and guides for learners to build their goals, and at the beginning of the MOOC and on a weekly basis, there are clear learning goals and schedules	☐	☐	☐	☐

Guideline and Checkpoint	What to test for	Testing method	NA	PA	LA	FA
	3. Goals, objectives, and schedules are in a prominent place					
Comments:						
6.2 Support planning and strategy development	1. There is embed to "stop and think" and "show and explain your work." 2. There are checklists for understanding the problem, setting up prioritisation, sequences, and schedules of steps 3. There are facilitators that model think-aloud of the process	There exist prompts to help with self-reflection and collaboration, there are checklists for the learner to set up the prioritisation of tasks and facilitators play the role to help on the think-aloud process	☐	☐	☐	☐
Comments:						
6.3 Facilitate managing information and resources	1. There are templates for data collection and organising information 2. There are checklists and guides for note-taking	When needed there are templates offered to help to coordinate the information and data, help to produce profitable note-taking is provided	☐	☐	☐	☐
Comments:						
6.4 Enhance capacity for monitoring progress	1. There are available questions to guide self-monitoring and reflection 2. It is shown representations of progress 3. Learners can identify the type of feedback or advice that they are seeking 4. Some templates guide self-reflection and self-assessment on quality and completeness	There are questions and templates to help self-reflection, the progress in the MOOC is shown, it is easy to look for help and feedback, it is indicated	☐	☐	☐	☐
Comments:						